Groundwater Modeling
U.S. Department of Energy
Office of Legacy Management

Groundwater modeling involves parameter estimation.

Memorandum of Understanding
Between the US DOE and US NRC on cooperation in the area of operating experience and applications of data analytics (Signed June 2021)
U.S. Department of Energy
Office of Environment, Health, Safety & Security

The purpose of the Memorandum of Understanding (MOU) between the US DOE and US NRC is to efficiently use resources and to avoid needless duplication of effort by sharing data, technical information, lessons learned, and, in some cases, the costs related to the development of approaches and tools. Wherever such cooperation and cost sharing may be done in a mutually beneficial fashion. The technical interests for collaboration include those related to operating experience and safety data collection and analyses, including operational events, occupational injuries, hazardous substance releases, and accidents and accident precursors, trending analysis, and risk-informed decision-making. Applications of data analysis of operating experience and safety data, including data visualization and analysis, artificial intelligence, machine learning, natural language processing, predictive analytics, and other advanced analytics techniques, user interface design, and deployment, and decision-making using data analytics tools.

Date Development/ Acquisition Began
2018-01-01
Date Implemented
2020-01-01
Contact Name
Kathleen Whysner
Contact Email
kathleen.whysner@lm.doe.gov
Developer Information
Commercial-off-the-shelf
Consistent with EO 13898
AI Techniques Used
N/A
Training Data Origin
Yes
Releasable to the Public
Yes

Soil Moisture Modeling
U.S. Department of Energy
Office of Legacy Management

Use multisource machine learning to model soil moisture within the volumeter embedded within a disposal cell.

Machine Learning for Autonomous Control of Scientific User Facilities
U.S. Department of Energy
Brookhaven National Laboratory

BNL will work alongside SLAC to implement ML algorithms into NLSL-II Operations to interpret accelerator data more intelligently. We intend to train said algorithms with 5+ years of archived device-data from accelerator components, records of previous fault causes (to connect to data-symptoms) and stored beam current.

Automated sorting of high repetition x-ray coherent diffraction data from XFELs
U.S. Department of Energy
Brookhaven National Laboratory

"Coherent X-rays are routinely provided today by the latest Synchrotron and X-ray Free-electron Laser Sources. When these diffraction from a crystal containing defects, interference leads to the formation of a modulated diffraction pattern called "speckle". When the defects move around, they can be quantified by a correlation analysis technique called X-ray Photon Correlation Spectroscopy. But the speckles also change when the beam moves on the sample. By scanning the beam in a controlled way, the overlap between the adjacent regions gives redundancy to the data, which allows a solution of the inherent phase problem. This is the basis of the coherent X-ray ptychography method which can achieve image resolutions of 10nm, but only if the probe positions are known. The goal of this proposal will be to separate "genuine" fluctuations of a material sample from the inherent beam fluctuations at the high data rates of XTEFA. Algorithms will be developed to calculate the correlations between all the coherent diffraction patterns arriving in a time series, then used to separate the two sources of fluctuation using the criterion that the "natural" thermal fluctuations do not repeat, while beam ones do. We separate the data stream into image and beam "modes" automatically."

Machine Learning for Linac Improved Performance
U.S. Department of Energy
Pern National Accelerator

In Linacs at FNAL and J-PARC, the current beamline optimization procedure is limited to manual adjustments of a few parameters; using a larger number is not practically feasible for a human operator. Using machine learning (ML) techniques allows lifting this restriction and expanding this set. Our goal is to integrate ML into linac operation - and in particular RF control to achieve a more optimal longitudinal emittance and lower overall losses.

AI Denoising
U.S. Department of Energy
Pern National Accelerator

This program aims to develop generative models for quickly simulating showers of particles in calorimeters for LHC experiments.

Next-Generation Beam Cooling and Control with Optical Stewart Cooling
U.S. Department of Energy
Pern National Accelerator

This project aims to address the big-data challenge and stringent time constraints facing multi-messenger astronomy (MMA) in neutrino experiments and cosmological surveys. Instead of following the traditional computing paradigm of moving data to the compute elements, it does the opposite: embed computation in the data where processing is performed in situ. This will be achieved through emerging computational storage accelerators on which ML algorithms may be deployed to execute MMA tasks quickly so alerts can be disseminated promptly.

High-dimensional data analytics for multi-messenger astrophysics in neutrino experiments and cosmological surveys
U.S. Department of Energy
Pern National Accelerator

In summary, computing for multi-messenger astronomy in neutrino experiments and cosmological surveys involves challenges such as high-dimensional data analytics, where traditional computing paradigms are insufficient. The project aims to develop strategies to embed computation in the data where processing is performed in situ, enabling real-time analysis and alert dissemination for multi-messenger astronomy.
<table>
<thead>
<tr>
<th>Title</th>
<th>Organization</th>
<th>Description</th>
<th>Start Date</th>
<th>Principal Investigator</th>
<th>Contact Email</th>
<th>In-House</th>
<th>Technology Focus</th>
<th>Data Status</th>
<th>Open-Source</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>This project will develop and deploy low-latency controls and prediction algorithms for algorithms running at the extreme edge.</td>
<td>U.S. Department of Energy</td>
<td>This project focuses on integration of AI hardware for at-scale inference at the Fermilab LINAC.</td>
<td>2021-05-10</td>
<td>Nhan Tran</td>
<td><a href="mailto:ntran@fnal.gov">ntran@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Streaming intelligent detectors for PHENIX/EIC</td>
<td>U.S. Department of Energy</td>
<td>This project will develop AI-based tools for event filtering with tracking detectors for nuclear physics collider experiments.</td>
<td></td>
<td>Nhan Tran</td>
<td><a href="mailto:ntran@fnal.gov">ntran@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Nu-pet AI for future tracking detectors</td>
<td>U.S. Department of Energy</td>
<td>This project explores novel AI-on-chip technology for intelligent detectors embedded with sensing technology.</td>
<td></td>
<td>Farah Fahim</td>
<td><a href="mailto:farah@fnal.gov">farah@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>SONIC: AI acceleration as a service</td>
<td>U.S. Department of Energy</td>
<td>This project focuses on integration of AI hardware for at-scale inference at the Fermilab LINAC.</td>
<td></td>
<td>Nhan Tran</td>
<td><a href="mailto:ntran@fnal.gov">ntran@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>High-Velocity AI Generative Models</td>
<td>U.S. Department of Energy</td>
<td>This project has two parts: 1. generating adversarial examples and then using domain adaptation and other techniques to improve the robustness of AI classification algorithms against those attacks (focusing on astrophysics/cosmology applications). 2. using AI algorithms to improve the output of low-quality classical simulation engines to deliver a high-quality result at high speed.</td>
<td></td>
<td>Kevin Pedro</td>
<td><a href="mailto:peders@fnal.gov">peders@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks, Hierarchical Generative Model</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Uncertainty Quantification and Instrument Automation to enable next generation cosmological discoveries</td>
<td>U.S. Department of Energy</td>
<td>This project will develop AI-based tools to enable critical sectors for near future cosmic applications. Uncertainty quantification is essential for performing discovery science now, and simulation-based inference offers a new approach. The automated design and control of instrument will be important for improving the efficiency of planning and executing cosmic experiments.</td>
<td></td>
<td>Brian Nord</td>
<td><a href="mailto:nord@fnal.gov">nord@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>READES: Real-time Edge AI for Distributed Systems</td>
<td>U.S. Department of Energy</td>
<td>This project will develop and deploy low-latency controls and prediction algorithms at the Fermilab accelerator complex.</td>
<td></td>
<td>Kyle Halsewood</td>
<td><a href="mailto:kjh@fnal.gov">kjh@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Simulation-based inference for astrophysics</td>
<td>U.S. Department of Energy</td>
<td>This project will develop and use simulation-based inference to estimate cosmological parameters related to cosmic acceleration in the early and late universe — via the cosmic microwave background and strong gravitational lensing, respectively. This will produce an analysis pipeline that can be deployed for next-generation cosmic surveys.</td>
<td></td>
<td>Brian Nord</td>
<td><a href="mailto:nord@fnal.gov">nord@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Extreme data reduction for the edge</td>
<td>U.S. Department of Energy</td>
<td>This project develops AI algorithms and tools for near-sensor data reduction in custom hardware.</td>
<td>2021-05-10</td>
<td>Nhan Tran</td>
<td><a href="mailto:ntran@fnal.gov">ntran@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Machine Learning for Accelerator Operations Using Big Data Analysis L-CAPE</td>
<td>U.S. Department of Energy</td>
<td>Big data analysis for anomaly prediction and classification, enabling automatic mitigation, operational savings, and predictive maintenance of the Fermilab LINAC.</td>
<td></td>
<td>William Pellico</td>
<td><a href="mailto:pellico@fnal.gov">pellico@fnal.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Geo Threat Observable for structure cyber threat related to the energy sector</td>
<td>U.S. Department of Energy</td>
<td>Collection of open source threat information related to cyber issues in the energy sector, collected stored in graphdb and used in machine learning for similarities of threat enabling better sense of cyber protections.</td>
<td>2019-10-01</td>
<td>Rita Foster</td>
<td><a href="mailto:Rita.Foster@inl.gov">Rita.Foster@inl.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Experimental data, open-source</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Deep Learning Malware Analytics for reusable cyber defenses.</td>
<td>U.S. Department of Energy</td>
<td>The RIL uses machine learning (feed forward neural network) on a large data set of translated malware binaries in graph structures to identify commonality between malware.</td>
<td>2017-10-01</td>
<td>Rita Foster</td>
<td><a href="mailto:Rita.Foster@inl.gov">Rita.Foster@inl.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>Data for malware binaries comes mainly from open source malware repositories collected. NLP used to scrape information off of cyber incident reports and websites, some data from cyber threat database and some data from manual threat analysis activities.</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Biology, genomics, and synthetic biology</td>
<td>U.S. Department of Energy</td>
<td>Combining experimental and computational methods to perform fundamental and applied research in genomics, molecular toxicology, nanotechnology, host-pathogen biology, structural biology, genomics, microbial systems, and medical countermeasures.</td>
<td></td>
<td>Kris Kulp</td>
<td><a href="mailto:Kulp@llnl.gov">Kulp@llnl.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>In-house</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Innovation methods, processes and training programs that can affect the speed and effectiveness of innovation processes at scale.</td>
<td>U.S. Department of Energy</td>
<td>Computational approaches that lead to faster insights into the development and deployment of large scale operations.</td>
<td></td>
<td>Charley Flodell</td>
<td><a href="mailto:flodell@llnl.gov">flodell@llnl.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>In-house</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Cyber security, data storage, and data management technologies</td>
<td>U.S. Department of Energy</td>
<td>Data-processing pipelines and user interfaces to process and aggregate large, bulk, and possibly unstructured datasets allowing for search and export of data for further analysis in secure way.</td>
<td></td>
<td>Brad Hart</td>
<td><a href="mailto:hart14@llnl.gov">hart14@llnl.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>In-house</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Advanced materials science, engineering, and exploration relevant to the other key technology focus areas</td>
<td>U.S. Department of Energy</td>
<td>Enabling machine learning based technology to specialized materials for superior performance for scientific research and manufacturing systems.</td>
<td></td>
<td>Bob Maxwell</td>
<td><a href="mailto:maxwell7@llnl.gov">maxwell7@llnl.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Big Data, Neural Networks</td>
<td>In-house</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Machine learning based identification of current hazardous offshore metocean and bathymetric conditions that can impact safe offshore energy operations

To use ML to help identify promising oxygen carrier materials

High-performance computing, semiconductors, and advanced computer hardware

Robotics, automation, and advanced manufacturing

To drive insights on the second pollutant as a function of pollutant concentration in the aqueous solution and computational design of a sorbent for maximum sorption of the second pollutant (TBD); Optimization calculations and ML fitting for the second pollutant (TBD); Optimization and computational design of a sorbent for maximum sorption of the second pollutant as a function of pollutant concentration in the aqueous solution.

To enhance the SimCCS toolset to better account for existing infrastructure and to more broadly engage other user bases to improve toolset performance and applicability

To analyze and apply machine learning algorithms to predict carbon dioxide emissions and energy improvements with rich gas in the Beld Creek Field and other selected fields. The results of these models will be compared with the predictions of CGM’s reservoir simulations models.

To develop a data platform to expedite access and reuse of carbon one data for materials, manufacturing and research. Assembled using data science, NLFP methods, and hosted in virtual, multi-cloud platform for online analysis.

Computational methods for the characterization of CO2 chemisorption in amine-functionalized MOFs.

ML-based approaches to improve site characterization efforts

Natural and anthropogenic disaster prevention and mitigation

Advanced-energy, batteries, and industrial efficiency

Quantum computing and information systems

AI/ML and other software advances

High-performance computing, semiconductors, and advanced computer hardware

Robotics, automation, and advanced manufacturing

To use ML to help identify promising oxygen carrier materials

Machine learning based identification of current hazardous offshore metocean and bathymetric conditions that can impact safe offshore energy operations

To use ML to help identify promising oxygen carrier materials

High-performance computing, semiconductors, and advanced computer hardware

Robotics, automation, and advanced manufacturing

To use ML to help identify promising oxygen carrier materials

Machine learning based identification of current hazardous offshore metocean and bathymetric conditions that can impact safe offshore energy operations

To use ML to help identify promising oxygen carrier materials

High-performance computing, semiconductors, and advanced computer hardware

Robotics, automation, and advanced manufacturing

To use ML to help identify promising oxygen carrier materials

Machine learning based identification of current hazardous offshore metocean and bathymetric conditions that can impact safe offshore energy operations

To use ML to help identify promising oxygen carrier materials

High-performance computing, semiconductors, and advanced computer hardware

Robotics, automation, and advanced manufacturing
To develop low cost conversion of coal to graphene
U.S. Department of Energy
National Energy Technology Laboratory
Demonstrate the techno-economic feasibility of a 250 t/year manufacturing facility to convert coal to high-quality graphene. The core technology is based on a fluidized bed technology with carbon monoxide as the reactant.key, quality, dimensions
2021-05-01
Jason Montgomery
jason.montgomery@netl.doe.gov
Contracted
Natural Language Processing, Neural Networks
Unknown
Yes

To implement machine learning to predict aerodynamic and combustion characteristics in hydrogen turbine
U.S. Department of Energy
National Energy Technology Laboratory
Design rules and reduced models will be formulated by combining high fidelity simulations of chemically reacting flow, stochastic modeling techniques, reduced modeling through machine learning and testing of injector configurations. These can be used in an industrial setting to predict the aerodynamic and combustion characteristics in hydrogen turbine configurations based upon which design decisions are made.
2021-03-15
Seth Lawson
seth.lawson@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

To automate development of proxy models for power generation combustion systems.
U.S. Department of Energy
National Energy Technology Laboratory
Developed CFD of large combustion systems will be performed. From the results, machine learning will be used to develop fast proxy models, which will provide results close to the CFD results, but in a small fraction of the time. These fast models will then be used in real-time digital twin models of the power plant, which can be used to help the power plant operator to spot instrumentation failures or cyberattacks on the plant.
2021-10-01
Steve Richardson
steven.richardson@netl.doe.gov
In-house
Other
Unknown
Yes

To implement unsupervised learning based interaction force model for nonspherical particles in incompressible flows
U.S. Department of Energy
National Energy Technology Laboratory
Develop a neural network-based interaction (drag and lift) force model. A database will be constructed of the interaction force between the non-spherical particles and the fluid phase based on the particle-reaction direct numerical simulation (PRDNS) with immersed boundary-based lattice Boltzmann method (LBIM). An unsupervised learning method, i.e., variational autoencoder (VAE), will be used to improve the diversity of the non-spherical particle library and to extract the primitive shape factors determining the drag and lift forces. This interaction force model will be implemented in a multilayer feed-forward neural network (MLF), which will be concatenated after the encoder of the previously trained VAE for geometry feature extraction.
2020-08-01
Richard Durul
richard.durul@netl.doe.gov
Contracted
Artificial Intelligence, Networks
Unknown
Yes

To develop 5G integrated edge computing platform for efficient component monitoring in coal-fired power plants.
U.S. Department of Energy
National Energy Technology Laboratory
Develop an on-demand distributed edge computing platform to gather, process, and efficiently analyze the component health data in coal-fired power plants. Given that edge computing servers are closer to the field devices in modernized power plants, the efficiency of edge computing service with respect to dynamic orchestration, resource data collection, and health information monitoring will be investigated for timely detection of remote faults and to perform diagnosis.
2021-06-23
Rob Lewis
roblew@netl.doe.gov
Contracted
Big Data
Unknown
Yes

To identify and characterize REE-CM hot zones using machine learning-enabled multi-physics
U.S. Department of Energy
National Energy Technology Laboratory
Develop and field demonstrate a machine learning (ML)-aided multi-physics approach for rapid identification and characterization of REE-CM hot zones in mine tailings with a focus on coal and sulfide mine tailings or other processing or abstraction/hypabase, such as ash and refuse deposits.
2023-01-01
Heather Dougherty
heather.dougherty@netl.doe.gov
In-house
Artificial Intelligence
Unknown
Yes

To implement boiler health monitoring using a hybrid first principles-artificial intelligence model.
U.S. Department of Energy
National Energy Technology Laboratory
Develop methodologies and algorithms to yield a hybrid first-principles artificial intelligence (AI) model of a PC boiler. (2) a physics-based/approach to material damage informed by ex-service component evaluation, and (2) an online-health-monitoring framework that synergistically leverages the hybrid models and plant measurements to provide the spatial and temporal profile of key transport variables and characteristic measures for plant health.
2019-08-01
Maria Reispath
maria.reispath@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

Development of AI/ML methods
U.S. Department of Energy
National Energy Technology Laboratory
Develop quality, reliability, and version control standards for SMART software. Continue development of AI/ML methods for use by the 2A and 2C activities, including Modeling anomalies due to local heterogeneity coupled with an enhanced capabularity-resistance model (CRM) and Bayesian Belief Network (BBN) modeling integrated with geochemistry. Continue development of advanced computational approaches with modeling using the most advanced general purpose PDE/ODE physics-informed neural network (PINN) tool developed by NVIDIA and accelerate training PINNs using Wafer Scale Engine (WSE), by Cerebras Systems Inc.
2022-04-01
St. Kyle Underwood
mary.underwood@netl.doe.gov
In-house
Other
EDX - government datasets
Yes

Develop and demonstrate reinforcement learning approach for fine-tuning control for flexible hydrogen and power production.
U.S. Department of Energy
National Energy Technology Laboratory
Efforts on IES control will include the development of a dynamic optimization-based nonlinear model predictive control (NMPC) framework. NMPC approaches for optimizing cell thermal management and maximizing IES efficacy under set-point transition will be developed for flexible operation. Reinforcement learning (RL) approaches will also be developed for optimal control policy selection and learning-based adaptive control. There are opportunities for improved learning through interaction with the electrocatalyst in addition to learning from the MPC action. Multi-policy approaches will be developed for control, independently by RL, or in concert with MPC, or even for scheduling the operating policy. The ultimate goal is to develop operational strategies and an NMPC and RL control framework for optimizing IES performance under flexible hydrogen and power production scenarios, while minimizing physical and chemical degradation over long-term operation.
2022-04-01
Sandra Bossa
sandra.bossa@netl.doe.gov
In-house
Other
Open-source and publications
Yes

Neural networks used to compensate a drone-mounted magnetic sensor for maneuvering of the drone.
U.S. Department of Energy
National Energy Technology Laboratory
Electromagnetic technology development and optimization for paced fields. Satellite sidewalks—getting to 100,000 wall/year through drone technology and ML technology, NETL will develop ML algorithms to compensate magnetic data for the maneuvering of drone aircraft. Magnetic noise can limit sensitivity of detection and navigation and impede mapping in the magnetic data. The ML algorithms will reduce altitude and heading-related noise in magnetic surveys.
2022-04-01
Brian Dressel
brian.dressel@netl.doe.gov
In-house
Neural Networks, Other
Datasets provided by private sector collaborators
Yes

To provide natural gas leak detection and quality control
U.S. Department of Energy
National Energy Technology Laboratory
Employing machine learning techniques to train sensing systems to quantify the concentration of natural gas species, distinguish between natural gas at different parts of the processing pipeline, and distinguish natural gas from natural and man-made interfering sources such as wildfires and agriculture.
2020-04-01
Joseph Renk
joseph.renk@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

**Collaborators**
- DoD (General Electric)
- DOE (Oak Ridge National Laboratory)
- DOE (Pacific Northwest National Laboratory)
- DOD (Army)
- DOD (Pentagon)
- NASA
- DOE (National Energy Technology Laboratory)
- DOE (Sandia National Laboratories)
- DOE (National Renewable Energy Laboratory)
To design, develop, and demonstrate an Air-Integrated physics-based attack resilient proactive system.
U.S. Department of Energy
National Energy Technology Laboratory
Enable "falselee-in-depth" cyber-physical system (CPS) security and resiliency for the distribution grid. The recipient will design, develop, and demonstrate a vendor-agnostic scalable Artificial Intelligence Integrated Attack-Resilient Proactive System (AI-ARPS) for utility distribution grid systems including advanced distribution management system (ADMS) and DER management system (DMDRM) applications.
2022-10-01
J. Clark Robinson
clark.robinson@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

To apply machine learning methods to explore the inter-well uncertainty in the Goldsmiths Lenthall San Andres Unit and to update reservoir models.
U.S. Department of Energy
National Energy Technology Laboratory
Engineered water can lower interfacial tension and minimize capillary forces that gravity can push the oil up and out of the matrix. This proposal is to test this technology in the field scale, in Goldsmiths Lenthall San Andres Unit. Apply history matching of feasible interface-steam and steam injection operations and use a physics-based attack resilient adversarial networks that provide new methods to explore the inter-well uncertainty and to update the reservoir models.
2019-10-01
Anthony Zammerilli
anthony.zammerilli@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

Use AI to process large sensor datasets for identification and classification of NGL pipeline leaks and methane leaks.
U.S. Department of Energy
National Energy Technology Laboratory
Focus on development of advanced analytic techniques and methods for distributed OFS technology, including AI and NLP, for identification of signatures and pattern recognition of hazards, defects, and operational parameters of the natural gas pipeline networks.
2022-04-01
Sandra Borek
sandra.borek@netl.doe.gov
In-house
Big Data, Other
Unknown
Yes

ML-based reduced order models of reservoir response to CO2 injection into saline and/or hydrocarbon-bearing formations - as the basis for integrated assessment modeling of leakage risk (e.g., SACROC).
U.S. Department of Energy
National Energy Technology Laboratory
Generally, the approach used by NRM researchers to address these questions is to develop a robust, science-based integrated assessment framework that links field forecasting models of CO2 storage system components (e.g., storage reservoir: leakage pathways including wells, faults, and fractured caprock; interihnite formation; and reservoirs of concern, including groundwater aquifers and the atmosphere). Superposed on this system model are various & for-purpose analytical capabilities that support analyses in support of stakeholder decision making for questions related to site-specific risk evolution, risk-based area of review delineation, conformance assessment, and post-injection site monitoring. In Task 2.0, researchers will augment and expand the functionality to determine relevance to industry-standard site risk management planning. In addition to the above, researchers will perform a sensitivity analysis to quantify the impact of uncertainties in the containment performance and leakage risk for scenarios where site contamination is from CO2 glution (storage for dedicated CO2 storage. To ensure that risk assessment efforts are informative to real geological storage deployment scenarios, NRM researchers will engage with a diverse set of stakeholders to establish an appropriate modeling and risk assessment design basis.
2022-04-01
M. Kylee Underwood
mary.underwood@netl.doe.gov
In-house
Other
Unknown
Yes

Transform reservoir management decisions through rapid analysis of real-time data to visualize forecasted behavior in an advanced control room "human-in-the-loop" format.
U.S. Department of Energy
National Energy Technology Laboratory
Improve low-fidelity model performance by transition-learning with high-fidelity data, and reduce uncertainty by combining high-fidelity and low-fidelity models for improved UOC performance.
2020-04-01
Jerry Carr
jerry.carr@netl.doe.gov
In-house
Other
Unknown
Yes

Natural Language Processing
U.S. Department of Energy
National Energy Technology Laboratory
Information and articles on energy storage will be gathered and reviewed. Developed natural language processing (NLP) algorithms will be used to help categorize and understand various energy storage efforts in the R&D communities. Additionally, trends within the discovered and selected topical focus areas in energy storage will be examined. This will provide a view of energy storage R&D, which is not biased or limited to known search terms.
2022-04-04
Jerry Carr
jerry.carr@netl.doe.gov
In-house
Big Data, Natural Language Processing, Other
Literature Metadata from Semantic Scholar Academic Graph

To apply machine learning and data analysis techniques to integrated subsurface datasets to predict key reservoir properties and compare various fields across the area of study and to correlate vintage data with new data and address the distribution of fractures and vugs.
U.S. Department of Energy
National Energy Technology Laboratory
Laboratory experiments will be used to optimize a CO2 flood composition specific to HTF rock properties, and subsequently design and simulate injection scenarios that offer weightiness alleviation, foaming, and reduced surface tension. This work will improve oil recovery from matrix-poorly aligned and mitigate the impact of fracture zones. The optimized design will be implemented and tested in a Trenton/Black River field. The results will provide strategies to improve recovery in complex carbonate formations in the Michigan Basin as well as other carbonate plays.
2019-10-01
Kyle Clark
kyle.clark@netl.doe.gov
Contracted
Artificial Intelligence, Big Data
Unknown
Yes

DOE AI Data Infrastructure System
U.S. Department of Energy
National Energy Technology Laboratory
Promoting generative AI and cloud-based data infrastructure to improve CCS user experience and connectivity producing an adaptive user interface that streamlines connection of CCS stakeholders to what matters to them.
2022-04-04
M. Kylee Underwood
mary.underwood@netl.doe.gov
Artificial Intelligence, Big Data, Other
Open-source and government datasets

To define insights on environmental performance of the natural gas system to inform effective mitigation strategies
U.S. Department of Energy
National Energy Technology Laboratory
Life Cycle Analysis models will be used to define and estimate environmental parameters/performace.
2018-04-01
Sandra Borek
sandra.borek@netl.doe.gov
In-house
Big Data, Other
Unknown
Yes

To improve control of hybrid SOFC gas turbine power systems.
U.S. Department of Energy
National Energy Technology Laboratory
Machine learning algorithms are being developed and compared to other control methods for SOFC/cfgas hybrid power generation systems.
2021-10-01
Steve Richardson
steven.richardson@netl.doe.gov
In-house
Other
Unknown
Yes

To create reduced order models for predicting long-term performance degradation behavior of fuel cells and electrocatalysts.
U.S. Department of Energy
National Energy Technology Laboratory
Machine learning algorithms are being used to analyze large datasets of microstructural and performance degradation simulations of various electrode microstructures to develop reduced order models that can be used for long-term performance degradation predictions of large area fuel cell/electrolysis cells and cell stacks. The reduced order models can be used for dynamic simulations that can more accurately mimic the changing loading conditions of the modern grid.
2019-07-01
Steve Richardson
steven.richardson@netl.doe.gov
In-house
Big Data, Other
Unknown
Yes

To develop a novel platform for secure data logging and processing in fossil fuel power generation systems using blockchain and machine learning to reduce down time for fossil energy power plants, limit reductions of power and reduce cost for repairs.
U.S. Department of Energy
National Energy Technology Laboratory
Machine learning model development will consist of traditional machine learning and deep learning algorithm implementation for anomaly detection. Machine learning server will be used to develop the traditional models using One-Class Support Vector Machine (OCSVM) and K-Means Clustering and deep learning models using Recurrent Neural Networks (RNN) and its various implementation like Long Short Term Memory (LSTM), Gated Recurrent Unit (GRU), Generative Adversarial Networks (GAN), and Autoencoders using the sensor data collected from secure sensor network.
2019-09-01
Heather Hunter
heather.hunter@netl.doe.gov
Contracted
Artificial Intelligence, Neural Networks
Unknown
Yes
Creation of polymer datasets and inverse design of polymers with targeted backbones having high CO2 permeability and high CO2/N2 selectivity.

U.S. Department of Energy, National Energy Technology Laboratory

Machine learning models were developed to predict CO2 permeability and CO2/N2 selectivity of designed polymers and designed networks were developed to generate polymer datasets. Furthermore, a novel machine learning approach is being developed to inverse design the polymers that will have targeted properties.

2022-04-01 Viktoria L Pretzman laura.pretzman@netl.doe.gov In-focus Other Approximately 400 research papers Yes

To leverage expanded data to update assessments, analyze, and inform for NAPL and CS Atlas

U.S. Department of Energy, National Energy Technology Laboratory

ML is utilized to parse and generate additional data and information that can be parsed and labeled to provide additional inputs for geologic carbon storage assessments from multiple sources.

2016-04-01 Sandra Borek sandra.borek@netl.doe.gov In-focus Other Unknown Yes

To drive insights on pipeline maintenance and repair strategies to reduce incidents of pipeline leakages, support evaluation of use and reuse strategies

U.S. Department of Energy, National Energy Technology Laboratory

ML will be used to develop a pipeline risk assessment genospatial model and support evaluation of use and reuse opportunities.

2022-04-01 Sandra Borek sandra.borek@netl.doe.gov Big Data, Other Unknown Yes

To drive insights using machine learning-based dynamic, control, and health models and tools developed by NETL to gain valuable operational data, insights, and decision-support frameworks.

U.S. Department of Energy, National Energy Technology Laboratory

ML-based proxy-models and multi-level data-driven fracture network imaging to support rapid decision making.

2020-04-01 Jerry Carr jerry.carr@netl.doe.gov In-focus Other Unknown Yes

Use ML to enable a geophysical monitoring tools, and accelerate real-time modeling and data assimilation tasks (e.g., monitoring and decision-support frameworks), work together to radically improve pressure and stress imaging.

2020-01-01 M. Kyle Underwood mary.underwood@netl.doe.gov In-focus Other Unknown Yes

Advanced subsurface imaging, lower energy cost, impacts, and improved resolution

U.S. Department of Energy, National Energy Technology Laboratory

More detailed analysis and simulation of a closed cycle pulsed MHD generator will be performed in this subtask. The numerical code will be used to produce an optimized system which achieves a 10 MW peak power output over a 1% duration with a total duty cycle of 2 minutes. The expected output of this task is an optimized concept as a function of the various input and design parameters for the system (e.g., magnet size, Pebble bed heater size).

2020-04-01 Christy Pecyna christy.pecyna@netl.doe.gov In-focus Artificial Intelligence, Other Government datasets, open-source datasets Yes

Advanced subsurface imaging, lower energy cost, impacts, and improved resolution

U.S. Department of Energy, National Energy Technology Laboratory

More detailed analysis and simulation of a closed cycle pulsed MHD generator will be performed in the subtask. The numerical code will be used to produce an optimized system which achieves a 10 MW peak power output over a 1% duration with a total duty cycle of 2 minutes. The expected output of this task is an optimized concept as a function of the various input and design parameters for the system (e.g., magnet size, Pebble bed heater size).

2019-04-01 Christy Pecyna christy.pecyna@netl.doe.gov In-focus Artificial Intelligence, Other Government datasets, open-source datasets Yes

Advanced subsurface imaging, lower energy cost, impacts, and improved resolution

U.S. Department of Energy, National Energy Technology Laboratory

More detailed analysis and simulation of a closed cycle pulsed MHD generator will be performed in this subtask. The numerical code will be used to produce an optimized system which achieves a 10 MW peak power output over a 1% duration with a total duty cycle of 2 minutes. The expected output of this task is an optimized concept as a function of the various input and design parameters for the system (e.g., magnet size, Pebble bed heater size).

2021-04-01 Christy Pecyna christy.pecyna@netl.doe.gov In-focus Artificial Intelligence, Other Government datasets, open-source datasets Yes

To provide insights into opportunities to benefit and use hydrocarbon infrastructure for alternative uses such as offshore carbon storage.

U.S. Department of Energy, National Energy Technology Laboratory

Multiple big data-driven AI/ML models will be used to evaluate geologic, geospatial, and infrastructural related information to inform predictions using natural language processing, Artificial Neural Networks, and possibly Bayesian networks as well.

2021-04-01 Christy Pecyna christy.pecyna@netl.doe.gov In-focus Big Data, Other Unknown Yes

To evaluate current infrastructure throughout a study area and evaluating future infrastructure needs to accelerate the deployment of CCUS

U.S. Department of Energy, National Energy Technology Laboratory

One key task focuses on evaluating current infrastructure throughout the initiative study area and evaluating future infrastructure needs to accelerate the deployment of CCUS. LANA will utilize unique technologies for this project focusing on the CCUS, including a focused consulting role using ML and machine learning algorithms.

2019-10-01 Dawn Deel dawn.deel@netl.doe.gov In-focus Artificial Intelligence Yes

Demonstrate the robust performance of our ML method in a commercial-scale synthetic data environment to demonstrate the translation to convolutional neural networks.

U.S. Department of Energy, National Energy Technology Laboratory

Our method quickly incorporates streaming observations for accurate and timely forecasts with uncertainty quantification, by leveraging realistic simulation data as inputs and incorporating real-time observation streams for accurate, timely geological carbon storage forecasts. Convolutional networks are distributed over many machines, facilitating scalable models trained on many ML models, and allows for ML-CNN optimization and weighting analysis.

2020-04-01 M. Kyle Underwood mary.underwood@netl.doe.gov In-focus Other Unknown Yes

To develop drag models for non-spherical particles through machine learning

U.S. Department of Energy, National Energy Technology Laboratory

Produce comprehensive experimental and numerical datasets for gas-solid flows in well-controlled settings to understand the aerodynamics of non-spherical particles in the dense regime. The datasets and the applied knowledge will then be used to formulate a general drag model for use directly in NETL MFI/DEM models. This will help in advancing the accuracy and prediction fidelity of the computational tools that will be used in designing and optimizing fluidized beds and chemical looping reactors.

2020-05-01 Omer R. Bakahi omer.bakahi@netl.doe.gov Contracted Artificial Intelligence, Other Unknown Yes
To fill critical data gaps in big data analysis and machine learning applications to inform decision making and improve the ultimate recovery of unconventional oil and natural gas resources.

U.S. Department of Energy National Energy Technology Laboratory
Project will conduct numerical analysis of all digital pressure sensing technology will be used to create a synthetic dataset with downhole pressure sensor readings for each stage and will be analysed statistically with DA to integrate with software.

2019-10-01 David Kercone david.kercone@netl.doe.gov Contracted Artificial Intelligence, Big Data Unknown Yes

To design, prototypize and demonstrate a miniaturized implementation of a multi-process, high-spatial-resolution monitoring system for boiler condition management

U.S. Department of Energy National Energy Technology Laboratory
Project will develop control logic for automated control of high-spatial resolution monitoring system in case of local temperature multi-process, high-spatial resolution monitoring system will signify damaging conditions in that region of the boiler, and what operational changes can be made to eliminate the damaging condition. The control logic will be developed for automated control of coal-burning and other boiler operations.

2018-10-01 Richard Dunst richard.dunst@netl.doe.gov Contracted Unknown Yes

To provide combustion performance test and emitters optimization through integration of a miniaturized high-temperature multiprocess monitoring system

U.S. Department of Energy National Energy Technology Laboratory
Project will develop control logic for automated control of lignite coal-fired boiler. Plant operational data will be compared against monitoring data to determine what different sensor output from a miniaturized high-temperature multi-process, high-spatial-resolution monitoring system signifies damaging conditions in that region of the boiler, and what operational changes can be made to eliminate the damaging condition. The control logic will be developed for automated control of coal-burning and other boiler operations.

2018-06-01 Omar P. Bakshi omar.bakshi@netl.doe.gov Contracted Unknown Yes

Development of new machine learning-based process modeling capabilities that assess the viability and efficiency, with uncertainty quantification, of the chemical processes involved in the carbon fiber production and its output quality

U.S. Department of Energy National Energy Technology Laboratory
Provide sub-pixel scale verification of cloud-scale developments on the production of isotropic and mesophase carbon pitch (MCP) for carbon fiber production, using costs from several U.S. coal-producing regions. An extensive database and suite of tools for data analysis and economic assessment will be developed to relate process conditions to product quality, and to assess the economic stability of coke from different regions for producing specific high-value products.

2020-06-01 Christian Robinson christian.robinson@netl.doe.gov Contracted Artificial Intelligence Unknown Yes

Analysis to Assess Offshore CCS Trends and Gaps

U.S. Department of Energy National Energy Technology Laboratory
Providing expertise, input, and support for the development of a DOE (NETL) decision support system (DSS) that guides decisions for offshore CCS projects. This work will include the development of an off-the-shelf technology focused on delivering real-time insights into the offshore CCS projects.

2022-04-01 Mary Underwood mary.underwood@netl.doe.gov In-house Other Open-source Yes

Initial case study using regulatory compliance (well integrity testing, fluid compositional data, geographic, and geotechnical information from oil and gas wells in the Williston Basin, Denver Basin, central Colorado, USA). The study will involve analyzing data from over 20,000 wells to assess the impact of regulatory compliance on well integrity and identify areas for improvement.

U.S. Department of Energy National Energy Technology Laboratory
Researchers will apply artificial intelligence/machine learning (AI/ML) techniques to national-scale well characterization and integrity test datasets to yield new insights into leakage potential.

2022-04-01 Sandra Boni sandra.boni@netl.doe.gov In-house Other Unknown Yes

UNET and other approaches for ML-based inversion

U.S. Department of Energy National Energy Technology Laboratory
Researchers will develop a design tool for high-fidelity modeling considering data dimensionality, uncertainty, and inter-module connectivity, and define the components of the monitoring design optimization tool (GREATM) to be incorporated into NMPF-MAP and the SMART platform.

2022-04-01 Mary Underwood mary.underwood@netl.doe.gov In-house Artificial Intelligence, Other Unknown Yes

To develop a wireless, distributed data acquisition and interpretation system for the seismic monitoring and characterization of carbon storage resources.

U.S. Department of Energy National Energy Technology Laboratory
Resource decay in a wireless, distributed data acquisition and interpretation system (CDI) for seismic monitoring and characterization of carbon storage resources will be achieved in real-time for carbon storage characterization processes. The system will be integrated with enhanced signal processing and machine learning techniques to provide real-time monitoring and characterization of carbon storage resources.

2022-06-27 Ashley Urosek ashley.urosek@netl.doe.gov Contracted Artificial Intelligence Unknown Yes

To research and develop physics-aware and AI-enabled cyber-physical intrusion response for the power grid

U.S. Department of Energy National Energy Technology Laboratory
Responding to anomalous cyber and physical events in a timely manner requires having data from both cyber and physical sensors into actionable information. Thus, cyber-physical intrusion response research will be conducted that leverages cyber and physical side data and models with artificial intelligence (AI) as a scalable approach to maintain or regain power system resilience under anomalous incidents such as cyber threats.

2022-10-01 Rob Hayes robert.hayes@netl.doe.gov Contracted Artificial Intelligence Unknown Yes

To implement sensor-driven deep learning/artificial intelligence for power plant monitoring

U.S. Department of Energy National Energy Technology Laboratory
Sensor-driven deep learning/artificial intelligence for intelligent health monitoring capabilities that occur in the sensor (embedded computing) or base station (edge computing). Will give power plant operators more prediction tools about scheduled maintenance. Focus is on a high-priority variable boiler temperature measurement system that relies on chip-scale RFID technology and much-needed temperature, pressure, environmental, and world quality industrial sensors.

2021-08-16 Rob Lewis rob.lewis@netl.doe.gov Contracted Artificial Intelligence, Neural Networks Unknown Yes

To drive insights on water recovery from cooling tower plumes

U.S. Department of Energy National Energy Technology Laboratory
Study of plume formation and collection on mechanical (induced) draft cooling towers, partly in a high-fidelity controlled environment and partly on a full-scale industrial cooling tower. Will start by building the needed equipment to deliver test conditions and install it in a lab environment. At the same time a computational fluid dynamics (CFD) model will be implemented to simulate the tower and plume formation. Using the insights into power-plant plumes characteristics the project will iterate on and experimentally test electrodes and collection, which make up module panels, on the lab cooling tower. What has been learned from the full-scale plant modeling and sensor data analysis will then be applied to develop a design model to build the optimal collection apparatus for given working conditions.

2019-10-01 Heather Hunter heather.hunter@netl.doe.gov Contracted Unknown Yes
To use AI to calibrate the simulation model by matching simulation data with production history data.

U.S. Department of Energy
National Energy Technology Laboratory
Task 2: Together with GENM, CMU’s in-house optimization and analysis tool, CMOST Artificial Intelligence (AI), will be used to calibrate the simulation model by matching simulation results with production history data. Based on the data sets, a series of simulation cases will be generated to perform parameter estimation using a systematic approach. At simulation job completion, the results will be evaluated using CMOST AI to determine how well they match production history. An optimizer will then determine parameter values for new simulation jobs.

2019-10-01
David Carcerone
david.carcerone@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

To automate RDE image analysis, machine learning for RDE image analysis is being employed.

U.S. Department of Energy
National Energy Technology Laboratory
The expected outcome of this project will be extensive experimental data that can provide valuable insight in RDC design, coupling RDC with turbomachinery, model validation, and real generation combuster sensors that use artificial intelligence and computer vision. Design of an optimized inlet to maximize pressure gain in an RDE relies on an understanding of the coupling between the inlet plenums (fuel and air), the combustor annular channel, and the exhaust diffuser. This creates a challenge for CFD as the models are significant and computationally expensive. NETL is continuing a collaboration with the University of Michigan to accelerate reacting flow CFD modeling using machine learning (ML).

2020-04-01
Brian Dressel (acting)
brian.dressel@netl.doe.gov
In-house
Other
Unknown
Yes

To develop and create an autonomous robotic inspection system.

U.S. Department of Energy
National Energy Technology Laboratory
The goal of the project is to prevent negative environmental and socioeconomic impacts of coal waste (coal ash and tailings) by developing an algal-based bioremediation and monitoring system of active and abandoned coal ash and tailings storage facilities. The first objective of this project is the development of a programmable drone, equipped with several complementary sensors that will autonomously monitor the condition of the ash and tailings piles. In addition, a decision support system that will use artificial intelligence and computer vision to analyze the sensor data and generate actionable recommendations will be developed.

2020-10-01
Jason Hasan
jason.hasan@netl.doe.gov
Contracted
Artificial Intelligence, Robotic Processing Automation (RPA)
Unknown
Yes

To provide integrated boiler management through advanced condition monitoring and component assessment.

U.S. Department of Energy
National Energy Technology Laboratory
The Integrated Creep-P fatigue Management System represents an online boiler damage monitoring system applicable to creep and fatigue. The system will be comprised of an online conformity to the plant data historian (e.g., OSIsoft PI) and a commercial finite element software (e.g., ANSYS and Abaqus). In addition, it will interface with finite element software, existing damage mechanism monitoring modules will also be deployed using online analytical calculations. This functionality will be applied to terminal tube entering the boiler header for which the combined mechanisms of creep and oxidation can be calculated without the need for a finite element analysis.

2019-01-01
Barbara Carnes
barbara.carnes@netl.doe.gov
Contracted
Unknown
No

Solving Field Equations on the Wafer Scale Engine

U.S. Department of Energy
National Energy Technology Laboratory
The intent is to develop a collocated, finite volume code to allow maximum mesh flexibility and support advanced CFD capabilities found in modern CFD codes like Fluent, OpenFOAM, and MFiX. NETL will take a matured approach to development towards a fully reacting CFD capability on the WSE. An inlet will be filled with API capability expansions needed to support general purpose CFD applications, such as general purpose finite volume formulations, collocated grid capabilities (finite & Choma interpolation), bit stuffing to save memory when dealing with cell types, general purpose boundary conditions and high speed communications. These expansions will be added to the WSE CFD framework to evolve the Snell’s Laws of Snell’s Laws towards a fully reacting CFD capability that will support problems of interest to PESC.

2022-04-01
Jerry Carr
jerry.carr@netl.doe.gov
In-house
Big Data, Other
Generated from CFD on the fly during testing
Yes

Using time-series classification to assist in automated analysis of sensor data taken during experiments on the MHD test channel.

U.S. Department of Energy
National Energy Technology Laboratory
Measurements of chemical composition will be combined with resistance measurements to validate CFD models of the MHD channel system. Specifically, validated CFD models will be able to separate the contribution of the bulk and boundary layer resistance to the overall resistance of the MHD channel.

2021-04-01
Jerry Carr
jerry.carr@netl.doe.gov
In-house
Other
Experimentally obtained data
Yes

To develop and validate sensor hardware and analytical algorithms to lower plant operating expenses for the pulverized coal utility boiler fleet.

U.S. Department of Energy
National Energy Technology Laboratory
The objective is to develop and validate sensor hardware and analytical algorithms to lower plant operating expenses for the pulverized coal utility boiler fleet. The focus is on relatively inexpensive new “Internet of Things” technologies to minimize capital investment. Three technologies will be explored for demonstration and full-scale testing in a coal-fired power plant. The first focuses on gas and steam temperature control issues at the boiler header. The second uses sensors and analytic algorithms for monitoring coal pulverizer operation at low load to reduce the minimum firing capability of coal burners. The third investigates new sensors and advanced control to balance air and fuel at each burner enabling reduction in the minimum firing capability of coal burners.

2016-01-01
Diane Pavey Madzen
diane.madzen@netl.doe.gov
Contracted
Unknown
Yes

To leverage ML models to increase the size and complexity of problems that can be optimized within DAEES.

U.S. Department of Energy
National Energy Technology Laboratory
The objective is to leverage ML models as surrogate for complex unit operations or bridge between scales to increase the size and complexity of models that can be optimized within DAEES.

2021-04-01
Chrisy Pecyna
chrisy.pecyna@netl.doe.gov
In-house
No
Unknown
No

To realize next generation solid-state power substation.

U.S. Department of Energy
National Energy Technology Laboratory
The objective of the proposed project is to realize next generation solid-state power substations (SSPS) incorporating machine learning, cyber-physical anomaly detection, and multi-agent distributed network control. The project will have the following capabilities: distributed control and coordination coupled with localized intelligence and sensing, autonomous control for plug and play, automatic reconfiguration, recovery, and restoration enabling decoupled, asynchronous, and fractal systems.

2022-10-01
Joseph Dygert
joseph.dygert@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes

To develop innovative bioremediation and immobilization of heavy metals using phytotechnologies.

U.S. Department of Energy
National Energy Technology Laboratory
The objective of the work is to utilize algae and cyanobacterial-based phytotechnologies to address pervasive heavy metal contamination from coal combustion products (CCPs) at the Stewardson Mine in Illinois. Novel bioindicators will be developed to gauge the potential for phytoremediation to restore legacy impoundment sites.

2023-01-25
Heather Hunter
heather.hunter@netl.doe.gov
Contracted
Artificial Intelligence
Unknown
Yes
To use computational tools to optimize design of solid CO2 sorbents.

U.S. Department of Energy  National Energy Technology Laboratory

The objective of the project is to use computational tools to optimize the design of solid CO2 sorbents based on functionalized PIM-1 or other porous, glassy polymers impregnated with molecular primary amines. The expected outcome of this project is to inform, via computational methods, which polymer structure and which molecular amines can lead to a solid sorbent in which CO2 loading capacity, CO2 heat of adsorption, and overall CO2 mass transfer rate are optimal at extremely low CO2 partial pressures while amine leakage has been mitigated.

2022-04-01 Victoria L. Priemer  laura.priemer@netl.doe.gov  In-house  Other  In-house calculations and publications  Yes

To accelerate discovery of protection system and laser processing of protective coatings on CMC for hydrogen turbines.

U.S. Department of Energy  National Energy Technology Laboratory

The objectives of this project are to design, process, validate a laser-manufactured, integrated, and graded bond-coat-environmental barrier-coat-thermal-barrier-coat (BC-EBC-TBC) system that can effectively protect and lead to the use of Silicon Carbide fiber/Silicon Carbide (SiC/SiC) matrix CMCs in next-generation hydrogen fueled turbines.

2023-02-03 Omar R. Bakshi  omr.bakshi@netl.doe.gov  Contracted  Artificial Intelligence  Unknown  Yes

To develop an AI-driven integrated autonomous robotic bush inspection (RVI) platform.

U.S. Department of Energy  National Energy Technology Laboratory

The overall objective of the research is to develop an AI-driven integrated autonomous robotic bush inspection (RVI) platform that can perform real-time defect identification, dynamic path planning, and safe navigation in a closed-loop manner. The platform will combine an intuitive user interface and visualization capabilities from gaming software with the speed and enhanced detail in evaluating research dynamics and processes through ML, reduced order model approaches. Advancements made with ML will alleviate the need for both the expert user and the computational infrastructure and make understanding subsurface fluid flow accessible to the everyday user with a moderate level of understanding of the physics of the problem.

2020-01-01 M. Kylee Underwood  mary.underwood@netl.doe.gov  In-house  Other  Unknown  Yes

To provide an effective quality assurance method for additively manufactured gas.

U.S. Department of Energy  National Energy Technology Laboratory

The primary objective of the project is to develop an effective quality assurance (QA) method that can rapidly qualify laser powder bed fusion (LPBF) metal AM to fabricate HGPTC. The developed metadata package enables online/offline qualification of additively manufactured turbine components by inputting simulation with/without in-situ monitoring data; and ii) qualifying online/offline a QA tool intended for LPBF-processed HGPTCs by mining both simulation and in-situ/ex-situ characterization data. The project technical deliverable will be a rapid QA tool capable of: i) building a metadata package of process-structure-property data and models intended for LPBF-processed HGPTCs by mining both simulation and in-situ/ex-situ characterization data; and ii) qualifying online/offline a manufactured component by inputting simulation with/in-situ monitoring data to the developed algorithms to predict porosity and fatigue properties. The target application of the QA tool will be advanced HGPTC produced by LPBF in Phase I. Data mining techniques will be developed to consolidate and analyze the heterogeneous big data stream from the aforementioned methods of upfront simulation, online monitoring and post-build characterization, and thus enabling a collaborative learning about the process-microstructure-properties relationship. The resultant QA package includes a process-structure-property database and machine learning tools for using LPBF metal AM to fabricate HGPTC. The developed metadata package enables online/offline qualification of additively manufactured turbine components by inputting simulation with/in-situ monitoring data to the developed machine learning algorithms to predict porosity and fatigue properties.

2019-10-01 Mark C. Freeman  mark.freeman@netl.doe.gov  Contracted  Artificial Intelligence  Unknown  Yes

To deploy dynamic neural network implementation to minimize heat rate during ramping for coal.

U.S. Department of Energy  National Energy Technology Laboratory

The primary objective of the proposed work is to deploy dynamic neural network optimization (D-NNO) to minimize heat rate during all phases of operation (ramping, low load, and high load) at a coal power plant. The project will build on high-fidelity transient dynamic models of the plant for a rapid prototyping environment for the D-NNO and to allow researchers to better understand the dynamic phenomena that occur during ramping at various plant loads, and Commercialize D-NNO as a readily-available software application by working with an industry-driven software platform. The plant will be perturbed over time to allow machine learning (ML) models to be fitted to the plant’s response data.

2019-10-01 Barbara Carew  barbara.carew@netl.doe.gov  Contracted  Artificial Intelligence, Neural Networks  Unknown  Yes

To create a data-driven multiscale phenotyping technology framework for identification and remediation of washed-metals-contaminated soil.

U.S. Department of Energy  National Energy Technology Laboratory

The project objectives are to: i) integrate satellite remote sensing, machine learning and image processing, genetic engineering models, and chemical science and plant pathology; ii) identify potential leaching of metals from coal ash impoundments (Phase I); and 2) propose locally adaptable phytoextraction approaches to remediate contaminated regions (Phase II).

2022-10-01 Heather Hunter  heather.hunter@netl.doe.gov  Contracted  Artificial Intelligence  Unknown  Yes

To develop a general drug model for assemblies of non-spherical particles created with artificial neural networks.

U.S. Department of Energy  National Energy Technology Laboratory

The project plans to develop a more accurate artificial neural network (ANN)-based method for modeling the momentum exchange in solid multiphase mixtures to significantly improve the accuracy and reduce the uncertainty of multiphase numerical codes and, in particular, of MFiX, by developing and providing a general and accurate method for determining the drag coefficients of assemblies of non-spherical particles for wide ranges of Reynolds numbers, Stokes numbers, and fluid solid properties and characteristics. The research team will achieve this goal by conducting numerical computations with a validated in-house CFD code and using artificial intelligence methods to develop an ANN that will be implemented in TensawFlow and linked with the MFiX code.

2020-09-01 Adam Payne  adam.payne@netl.doe.gov  Contracted  Artificial Intelligence, Neural Networks  Unknown  Yes
Using AML to replace conventional geophysics inversion - does the process quicker than the typical method. Make-geophysical results more user-friendly.

**U.S. Department of Energy**

**National Energy Technology Laboratory**

The project will deploy a high sensitivity atomic magnetometer (potassium magnetometer or helium 4 magnetometer) on a UAV platform. Baseline surveys using the UAV platform with the magnetic receiver payload will be flown at the same CarbonSAFE site that baseline ground surveys were performed in EY21. Results of the forward modeling performed in EY20 will determine whether MT or CSEM (or both) methods will be used. Using AML, to replace conventional geophysics inversion - does the process quicker than the typical method. Make-geophysical results more user-friendly.

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Lead Agency</th>
<th>Lead Institution</th>
<th>Description</th>
<th>Start Date</th>
<th>End Date</th>
<th>Lead Contact</th>
<th>Email</th>
<th>Contracted</th>
<th>Artificial Intelligence, Neural Networks, Government models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use advanced machine learning techniques to analyze static and dynamic measurements of proppant distribution and fracture geometry data</td>
<td>U.S. Department of Energy</td>
<td>National Energy Technology Laboratory</td>
<td>The project will use advanced ML techniques to analyze static and dynamic measurement of proppant distribution and fracture geometry data from thousands of microchips injected with proppant near the wellbore.</td>
<td>2019-10-01</td>
<td>2021-06-30</td>
<td>Robert Noll</td>
<td><a href="mailto:robert.noll@netl.doe.gov">robert.noll@netl.doe.gov</a></td>
<td>Contracted</td>
<td>Artificial Intelligence, Unknown, Yes</td>
</tr>
<tr>
<td>Leverage machine learning and predictive analytics to advance the state of the art in pipeline infrastructure integrity management</td>
<td>U.S. Department of Energy</td>
<td>National Energy Technology Laboratory</td>
<td>The purpose of this project is to leverage advances in machine learning and predictive analytics to advance the state of the art in pipeline infrastructure integrity management using time-lagged (predicted) pipeline condition, using large scale pipeline integrity data (periodic, nondestructive inspection, NDI) and continuous operational data (e.g., sensor data used to monitor flow rate and temperature) generated by oil and gas (O&amp;G) transmission pipeline operators.</td>
<td>2018-10-01</td>
<td>2020-06-30</td>
<td>Eric Smiadak</td>
<td><a href="mailto:eric.smiadak@netl.doe.gov">eric.smiadak@netl.doe.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Unknown, Yes</td>
</tr>
<tr>
<td>To detect leaks and creaks</td>
<td>U.S. Department of Energy</td>
<td>National Energy Technology Laboratory</td>
<td>The relevant research has been focused on demonstrating applicability of novel machine learning-based approaches to two major challenges associated with safety management of large-scale geologic CO2 storage operations, early detection of leaks (i.e., by detecting small leaks) and early detection of induced seismicity (i.e. by detecting small seismic signals).</td>
<td>2022-08-01</td>
<td>2024-06-30</td>
<td>Jonathan E. Moore</td>
<td><a href="mailto:jonathan.moore@netl.doe.gov">jonathan.moore@netl.doe.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Unknown, Yes</td>
</tr>
<tr>
<td>To perform reconstruction of the 3D temperature field using Neural Networks with measured and known propagation paths</td>
<td>U.S. Department of Energy</td>
<td>National Energy Technology Laboratory</td>
<td>The sensor will first be tested up to 350 °C. For high-temperature tests, the Recipient will use Alston’s Industrial Size Burner Test Facility (ISBF) or another appropriate facility. The high-temperature sensor will be first tested from room temperature to 1,800 °C. The results will be compared with data obtained using other methods such as surface acoustic waves (SAW), thermocouples, and optical fiber sensors. A 3D temperature mapping will be created by fusing the high-temperature sensor data. The Recipient will test the system’s survivability in a boiler environment. A high-temperature sensing array will be tested to map the temperature field of a fuel bed during a 2D ignition test. The sensor will also be tested at one 6” port or a similar location. The Recipient will also perform reconstruction of the 3D field using Neural Networks with measured and known propagation paths.</td>
<td>2020-09-01</td>
<td>2022-06-30</td>
<td>Robbie Lewis</td>
<td><a href="mailto:Robbie.lewis@netl.doe.gov">Robbie.lewis@netl.doe.gov</a></td>
<td>Contracted</td>
<td>Artificial Intelligence, Unknown, Yes</td>
</tr>
<tr>
<td>Using ML to design sensing materials databases by simulating fracture geometry through high-fidelity synthetic microstructural data</td>
<td>U.S. Department of Energy</td>
<td>National Energy Technology Laboratory</td>
<td>The team proposes to develop an AI approach that relies upon established experimental and theoretical evidence to gain a comprehensive ML model and trained the gas sensing material design. The essence of this approach will be to assess material’s optimal performances at specific conditions, such as temperature, pressure, and ionization levels. The development of the package will occur in several steps: (1) building a materials database from various sources: (2) using ML techniques to build, evaluate, and optimize an ML model: (3) predicting the temperature dependence of sensing properties, such as gas selectivity, for FCCM-relevant gas species to screen the materials in the material bank, or proposing new sensing materials, and (4) exploring the gas sensing mechanisms suited for high-temperature applications for those predicted most promising gas sensing materials.</td>
<td>2022-08-01</td>
<td>2024-06-30</td>
<td>Steven Richardson</td>
<td><a href="mailto:steven.richardson@netl.doe.gov">steven.richardson@netl.doe.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Unknown, Yes</td>
</tr>
<tr>
<td>To drive insights into solid oxide cell performance and degradation through big data analysis and computer vision</td>
<td>U.S. Department of Energy</td>
<td>National Energy Technology Laboratory</td>
<td>The team uses deep learning models to analyze large banks of high-dimensional simulation results, determine the most impactful input parameters, produce tailored recommendations for industrial manufacturers, and ultimately generates a reduced-order model for predicting long-term performance of solid oxide cells. The team is also developing computer vision models to extend critical high-resolution information from easily obtained low-resolution or 2D microstructural data, and also using computer vision in near-infrared fast-inversion data, producing full sets of high-resolution 2D data from low-resolution 3D tomography or even from 2D micrographs. The team has recently developed and published a generative adversarial network model for generating high-fidelity synthetic microstructural data of solid oxide cells. Machine learning is also used in the team’s reduced order phase field simulations of microstructural changes.</td>
<td>2022-08-01</td>
<td>2024-06-30</td>
<td>Brian Dressel</td>
<td><a href="mailto:brian.dressel@netl.doe.gov">brian.dressel@netl.doe.gov</a></td>
<td>In-house</td>
<td>Artificial Intelligence, Neural Networks, Big Data, Other, Other, Generated in-house, and generally published or a part of published work, Yes</td>
</tr>
</tbody>
</table>
The team uses deep learning models to analyze large banks of high-dimensional simulation results, determine the most impactful input parameters, provide realistic catalyst formulation recommendations to commercial manufacturers, and ultimately generate a reduced-order model for predicting long-term performance of solid oxide cells. The team is also developing computing vision models to extract critical high-resolution information from easily obtained low-resolution images, such as 3D microtomography scans, and also using computer vision to super-resolve low-resolution data, producing full sets of high-resolution 3D data from low-resolution 3D tomography scans or even 2D micrographs. The team has recently developed and published a generative adversarial neural network for generating high-fidelity synthetic microstructural data of solid oxide cells. Machine learning is also used in the team's reduced order phase-field simulations of microstructural changes.

To drive insights into solid oxide cell performance and degradation through big data analytics and computer vision

U.S. Department of Energy
National Energy Technology Laboratory

2022-04-01
Brian Dressel (acting)
brian.dressel@netl.doe.gov
In-house

Large scale
Neural Networks, Deep learning
Other
Yes

Database will be utilized to demonstrate targeted seismic strategies using AI to assess large DNA datasets.

U.S. Department of Energy
National Energy Technology Laboratory

2022-04-01
Viktoria L. Pretman
laure.pretman@netl.doe.gov
In-house

Big Data, Other
Unknown
Yes

This task aims to use geo-data science methods and geospatial information science to analyze the existing H2 and natural gas pipelines to identify the key parameters that can enable the H2 transport and storage at a large scale.

U.S. Department of Energy
National Energy Technology Laboratory

2022-04-01
Sandra Borek
sandra.borek@netl.doe.gov
In-house

Big Data, Other
Unknown
Yes

Use ML to analyze the existing H2 and natural gas pipelines to identify the key parameters that can enable the H2 transport and storage at a large scale.

Rokbase Geologic Core Data Tool

2021-04-01
M. Kylee Underwood
mary.underwood@netl.doe.gov
In-house

Artificial Intelligence, Big Data, Other
Unknown
Yes

Using recursive neural networks and using fiber optic cables to recognize when operators a feature is coming

U.S. Department of Energy
National Energy Technology Laboratory

2021-04-01
M. Kylee Underwood
mary.underwood@netl.doe.gov
In-house

Neural Networks, Other
Government data and proprietary datasets by industry consortium
Yes

How to use DFT calculations to drive insights into solid oxide cell performance and degradation through big data analytics and computer vision

U.S. Department of Energy
National Energy Technology Laboratory

2021-04-01
Cheryl Pecyna
cheryl.pecyna@netl.doe.gov
In-house

Big Data, Natural Language Processing, Other
Open-source
Yes

Advanced model to forecast offshore landslide risks and marine permafrost

U.S. Department of Energy
National Energy Technology Laboratory

2016-04-01
Cheryl Pecyna
cheryl.pecyna@netl.doe.gov
In-house

Big Data, Natural Language Processing, Other
Open-source
Yes

Computational capabilities to support experimental efforts

U.S. Department of Energy
National Energy Technology Laboratory

2021-04-01
Sandra Borek
sandra.borek@netl.doe.gov
In-house

Synthetic data generated using first-principles methods
Yes

Neural Networks, Spatial-temporal
Graph Neural Networks, Other
Publications
Yes

The team will develop a public DNA database that will advance knowledge in proteomic water management. This project consists of two phases: (1) the development and launch of the database, and (2) the demonstration of applicability of the database by conducting a network analysis. The work will be pursued as defined in the phases below. The fully characterized strains will be used by other PIs to estimate overall resource recovery and will be used by other PI90% as training data in a machine learning algorithm. Other limited measurements can or have been completed for the produced water.

Data discovery, processing, and generation using machine learning for a range of CCSs data and information

U.S. Department of Energy
National Energy Technology Laboratory

2022-04-01
M. Kylee Underwood
mary.underwood@netl.doe.gov
In-house

Big Data, Natural Language Processing, Other
Unknown
Yes

Together, these workflows will: (1) provide an early warning of well-to-well communication, (2) predict the measured depths where the communication will happen, and (3) provide an estimated time until the beginning of well-to-well communication.

Fluid migration from well-to-well communication will be impacted to determine a cost-benefit analysis

U.S. Department of Energy
National Energy Technology Laboratory

2021-04-01
M. Kylee Underwood
mary.underwood@netl.doe.gov
In-house

Artificial Intelligence, Big Data, Other
Unknown
Yes

Using recursive neural networks and using fiber optic cables to recognize when sensors a feature is coming

U.S. Department of Energy
National Energy Technology Laboratory

2021-04-01
M. Kylee Underwood
mary.underwood@netl.doe.gov
In-house

Neural Networks, Other
Government data and proprietary datasets by industry consortium
Yes

This project will develop an ML algorithm to predict the time when a growing fracture will reach the monitored well. The ML algorithm will be trained on the distinctive tensile strain signature that precedes the growing fracture. The new workflow will be designed to work in conjunction with the fracture warning ML workflow developed in EY21. Together, these workflows will (1) provide an early warning of well-to-well communication, (2) predict the measured depths where the communication will happen, and (3) provide an estimated time until the beginning of well-to-well communication.

This project will develop an ML algorithm to predict the time when a growing fracture will reach the monitored well. The ML algorithm will be trained on the distinctive tensile strain signature that precedes the growing fracture. The new workflow will be designed to work in conjunction with the fracture warning ML workflow developed in EY21. Together, these workflows will (1) provide an early warning of well-to-well communication, (2) predict the measured depths where the communication will happen, and (3) provide an estimated time until the beginning of well-to-well communication.
Demonstrate how ML-based approaches can help operators during active injection and post-injection monitoring.

To develop artificial intelligence-enabled tools (AI/ML) for cyber hardening of power grids.

To develop and demonstrate dune-based geophysical and remote-sensing technologies to quantify critical minerals (CM).

To develop high fidelity tools which can in near real time not only help in the field to guide and optimize complex operations but can be used as digital twins for cyber security and cyber-physical modeling.

To build the first data analytics and artificial intelligence test laboratory for unconventional resources in the Powder River Basin, focusing on optimization of hydraulic fracture stimulations through the use of multiple diagnostic technologies.

To apply machine learning applications to map earth model, near-earth element, and critical mineral resources.

Using natural language processing to explore and extract information from historical literature/pdfs.

Advanced Image Segmentation

Machine Learning for geophysical data inversion.

Machine learning for legacy well evaluation.

Using AI to improve predictions of subsurface properties, analyze multiple variable inputs, address knowledge and information gaps to improve predictions and model.

Machine learning to process multi-model data and information to aid in the identification of underdeveloped orphaned wells.

To analyze data and derive insights and improve predictions to forecast wellbox kick events to reduce loss of control events.

To use data analytics and machine learning techniques to advance understanding of the characteristics of the Emerging Paradox Oil Play.

To help automate data integration and exploration for geologic core properties related information.

Machine learning to tool and model applications for CCS needs.

Machine learning to refine and analyze data for CCS needs.
To verify and validate fidelity of advanced power generation technologies

U.S. Department of Energy National Energy Technology Laboratory
Verification and validation testing with direct support and collaboration from operating power plants with advanced power generation technologies and prime mover and downstream systems using near-real-time data, resulting in better informed plant operation, and reduced disruptions, while meeting changing service demands based on enhanced operating flexibility.

- 2021-06-11
- Omer R. Bakshi
- omer.bakshi@netl.doe.gov
- Contracted
- Artificial Intelligence, Big Data
- Unknown
- Yes

Use of machine learning models to produce surrogates for efficient optimization

U.S. Department of Energy National Energy Technology Laboratory
We consider the use of machine learning models to produce surrogates for efficient optimization. The IDAES implementation will be demonstrated on a real-scale design problem focused on carbon capture (e.g., rigorous MEA model), or an integrated energy system.

- 2022-04-01
- Sandra Borek
- sandra.borek@netl.doe.gov
- In-house
- Other
- Open-source and publications
- Yes

Using ML to build predictive models of branching processes and develop novel algorithms for automated MIP solver tuning

U.S. Department of Energy National Energy Technology Laboratory
We will collect dual paps obtained as a result of using different branching strategies and feed them into ALAMO, Pyomo, and other machine learning approaches to build predictive models of branching strategies as a function of carefully chosen instance features. These models will then be deployed as part of the IDAES platform to facilitate optimization of advanced integrated energy systems. Currently, tuning MIP solvers for a particular application is approached by ad-hoc trial-and-error methods that are tedious and often ineffective, limiting design engineers in solution of small problems. To address this challenge and facilitate the solution of energy systems currently intractable, we will develop machine learning models that can be used to automate MIP solver tuning through the use of machine learning.

- 2022-04-01
- Jerry Carr
- jerry.carr@netl.doe.gov
- In-house
- Neural Networks, Other
- Unknown
- Yes

Develop, integrate, and automate the reduction of CFD models while preserving acceptable levels of fidelity for CFD applications

U.S. Department of Energy National Energy Technology Laboratory
We leverage state-of-the-art, physics-based deep learning (DL) models to learn generalizable surrogates that may be used in place of CFD models to predict quantities required for downstream optimization. The products from this work can be immediately leveraged by other stakeholders that are seeking to speed up their CFD simulation models to support the advancement of technologies.

- 2022-04-01
- Sandy Borek
- sandra.borek@netl.doe.gov
- In-house
- Other
- Open-source and publications
- Yes

To employ machine learning to study the dependence of electrochemical performance on microstructural details

U.S. Department of Energy National Energy Technology Laboratory
We will leverage state-of-the-art, physics-based deep learning (DL) models to learn generalizable surrogates that may be used in place of CFD models to predict quantities required for downstream optimization. The products from this work can be immediately leveraged by other stakeholders that are seeking to speed up their CFD simulation models to support the advancement of technologies.

- 2021-06-10
- Evelyn Lopez
- Evelyn.Lopez@netl.doe.gov
- Contracted
- Artificial Intelligence, Neural Networks
- Unknown
- Yes

With sensor technologies and network developed, in the future, AI/ML may be used to accelerate data processing of sensor data from the sensor network

U.S. Department of Energy National Energy Technology Laboratory
With sensor technologies and network developed, in the future, AI/ML may be used to accelerate data processing of sensor data from the sensor network to identify and predict risks and failures in plugged wells.

- Sandra Borek
- sandra.borek@netl.doe.gov
- In-house
- N/A
- Yes

Online real-time system identification

U.S. Department of Energy National Energy Technology Laboratory
Work will focus on using SI to monitor the condition of a power plant boiler at different process states. SI algorithms will be implemented within an MPC to provide continuous adaptability as the power plant processes through the entire range of operating loads. Once the control algorithm has been developed to be effective on representative models, it will be tested on a high-fidelity commercial power plant simulator or on real power plant facility. The online SI techniques will be tested on historical power plant data, dynamic models (including a power plant simulator), power-generating equipment including laboratory pilot-scale power systems, and on power plants where feasible.

- 2021-04-01
- Steven Richardson
- steven.richardson@netl.doe.gov
- In-house
- Artificial Intelligence, Big Data, Other
- Industrial power plants, Other
- Government
- Yes

To explore and analyze hydrogen-fed rotating detonation engines using advanced turbulent combustion modeling and high-fidelity simulation tools

U.S. Department of Energy National Energy Technology Laboratory
(1) analysis of injector design effects on RDE parasitic combustion; (2) understanding the impact of RDE ignition mechanisms and initial transients on the ensuing detonation wave behavior; (3) deployment and assessment of machine learning assisted turbulent combustion models for predictive and computationally-efficient RDE CFD simulations; and (4) development of a highly scalable high-order CFD modeling framework for scale-reversing simulations of full-scale RDEs and investigation of TCI and wall boundary layer effects.

- 2022-10-01
- Matthew Adkins
- Matthew.Adkins@netl.doe.gov
- In-house
- Artificial Intelligence
- Unknown
- Yes

Geochemically-Informed Leak Detection (GILD)

U.S. Department of Energy National Energy Technology Laboratory
A Bayesian Belief Network has been developed to interrogate the altered geochemistry around a potential CO2 leakage site. The use of BRN and site-specific parameters will reduce the percentage of false positives with this method.

- 2018-04-01
- Sandra Borek
- sandra.borek@netl.doe.gov
- In-house
- Artificial Intelligence, Other
- Unknown
- Yes
To develop a deep-learning Artificial Intelligence model for analysis of fundamental combustion characteristics
U.S. Department of Energy National Energy Technology Laboratory A deep-learning Artificial intelligence model will be pursued to rapid analysis of detailed fundamental combustion characteristics that support the design and model/factoring process of H2 containing fuel combustor development.
2021-08-01 Matthew Adams matthew.a.adams@netl.doe.gov Contracted Artificial Intelligence, Neural Networks Unknown Yes

Prediction of gasification gas yield and compositions using machine learning
U.S. Department of Energy National Energy Technology Laboratory A machine learning (ML) model will be developed to aid in investigating and optimizing gasification with various feedstocks like waste plastic, waste coal, biomass and MSW. Database on the gasification will be built from main resources of literature, prior experiments in NETL, and new generating experiments in NETL. An ML model will be a part of the project. It combines with experimental study to accelerate development of gasification applying to various feedstocks including waste plastics, waste coal, MSW and its mixture. The ML will have more impact as the big dataset will be built.
2021-04-01 Jerry Carr jerry.carr@netl.doe.gov In-house Big Data, Other

To implement novel SSC-CCS sensing technology and associated condition-based monitoring (CBM) software for improved understanding of the boiler tube failure mechanisms
U.S. Department of Energy National Energy Technology Laboratory A preliminary condition-based monitoring (CBM) package with a graphic user interface (GUI) will be developed. This GUI will allow the operators to view the current and historical signals of temperature profiles of the boiler tube at specific sensor locations. Combining the pre-existing condition site and the opinions from designers/operators/experts experiences, the system will be integrated with EPRI's Boiler Failure Reduction Program to provide assessments on the health conditions of the boiler tubes, warning/diagnoses on potential failures and locations, and suggestions on maintenance location issues and schedule.
2019-10-01 Richard Dural richard.dural@netl.doe.gov Contracted Unknown Yes

To develop fast predictive models using novel machine-learning based methods.
U.S. Department of Energy National Energy Technology Laboratory An AI & ML model is created. The model is trained to provide the foundation for the virtual learning platform. Generating training data then developing ML based models. Provides a virtual learning environment for exploring and testing strategies to optimize reservoir development, management & monitoring prior to field activities.
2021-04-01 Mary Underwood mary.underwood@netl.doe.gov In-house Other

To help automate data discovery and preparations to support a range of CS models, tools, and products
U.S. Department of Energy National Energy Technology Laboratory AI & ML are used to help collect and process data from multiple sensors to further integrate and characterization information to provide additional data and information to support a range of carbon storage work
2018-04-01 Sandra Borek sandra.borek@netl.doe.gov In-house Big Data, Natural Language Processing, Other

AI used to interpret sensor data
U.S. Department of Energy National Energy Technology Laboratory AI is being used to classify sensor data. An AI algorithm was written and trained with a wide range of known sensor conditions to enable automated classification of sensor data into likely constituent gas concentrations.
2021-04-01 Steven Richardson steven.richardson@netl.doe.gov In-house Big Data, Other

To accurately predict alloy & component performance extrapolated to: condition where experimental results to do not exist.
U.S. Department of Energy National Energy Technology Laboratory AN artificial intelligence-based model will be used to interrogate databases comprised of experimental data, literature data, and synthetic data generated improved physics based models. The model formulation will enable fast predictive Simulations using in-house Open-source software, as well as current snapping calculations.
2019-04-01 Steve Richardson steven.richardson@netl.doe.gov In-house Big Data, Other

To drive insights on emissions from natural gas production, storage, and transmission: to determine how best to reduce emissions.
U.S. Department of Energy National Energy Technology Laboratory AN artificial intelligence-based model will be used to recognize patterns in well integrity records that could predict failure events.
2018-04-01 Sandra Borek sandra.borek@netl.doe.gov In-house Big Data, Other

To develop an Artificial intelligence-based model for rotating detonation engine designs
U.S. Department of Energy National Energy Technology Laboratory An artificial intelligence-based model will be developed to develop low-loss rotating detonation engine (RDE) designs for use in power generation using natural gas/petroleum mixtures. The model formulation will enable fast RDE calculations over 100-1000 detonation cycles.
2019-10-01 Mark C. Freeman mark.freeman@netl.doe.gov Contracted Artificial Intelligence

To drive insights through data-driven predictive modeling to forecast the remaining lifespan and future risk of offshore production platforms.
U.S. Department of Energy National Energy Technology Laboratory An Artificial Neural Network and Gradient Boosted Regression Tree were developed and applied to predict the remaining lifespan of production platforms. These big data-driven models resulted in predictions with 99% confidence.
2018-04-01 Chris Pecyna chris.pecyna@netl.doe.gov In-house Artificial Intelligence, Big Data, Natural Language Processing, Other

AIIN Submodels of Reaction Kinetics
U.S. Department of Energy National Energy Technology Laboratory An ANN development of flow physics for code acceleration
2022-04-01 Jerry Carr jerry.carr@netl.doe.gov In-house Other

To demonstrate multi-gamma based sensor technology for as-fed coal property measurement
U.S. Department of Energy National Energy Technology Laboratory Applying an advanced multi-gamma attenuation (MGA) sensor to accurately and precisely measure coal properties at the point of injection into burners.
2019-10-01 Andrew Draves andrew.druve@netl.doe.gov Contracted Artificial Intelligence, Neural Networks

Applications of Natural Language Processing and Similarity Measures for Simplicity Ranking
U.S. Department of Energy Office of Environment, Health, Safety & Security TEHSS has been developing applications of natural language processing (NLP) and similarity measures for enhanced information retrieval and searching of databases (e.g., SQL databases, CSV files, reports) as well as estimating similarities between records within a dataset or records between different databases. Similarity has been successfully applied to efficiently search/DOE COVID-19 Hotline questions and answer database, searching DOE annual site environmental reports, similarities between DOE occurrence reporting and processing system and lessons learned, and AIX data. Similarity measures can also be used to identify opportunities for resource prioritization and prediction.
As of October 2021, the tool runs locally by the principal investigator on a desktop computer, as requested or as a desktop application.
2021-01-10 2010-10-01 Felix Gonzalez felix.gonzalez@netl.doe.gov In-house Art-Net or Required


<p>| Data Analytics and Machine Learning (DAML) Tools to enhance the analysis of Environment, Safety and Health (ES&amp;H) data Classification, Robotic Process Automation and Data Visualization | U.S. Department of Energy | Office of Environment, Health, Safety &amp; Security | The EHSS Data Analytics Machine Learning (DAML) tools: classification, robotic process automation and data visualization tool, uses natural language processing (NLP) and clustering algorithms (i.e., random forests) to automate the classification of records, visually provide insights in the trends and provide an indication of importance and risk. The tool leverages artificial intelligence (AI) to analyze the text extract of DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool has no restrictions on the text query, provides NLP options to the user (e.g., stemming or lemmatization) and could be used to improve decision-making in job planning activities, identifying hazards, and obtaining insights from operating experience and lessons learned data discovery and analysis. Additionally, the technology needs to provide a significant account, provide permissions, or create an MS Teams site as users in a consumable manner. Additionally, it would connect to ITSM primary benefit would be to make knowledge more available to the end-users. We are looking to have a single bot to interact with end-users. We are looking to have a single bot to handle the terms that may be used in an enterprise environment. The technology needs to support the project’s industry partners. The EHSS Data Analytics Machine Learning (DAML) tools, unsupervised machine learning clustering tool, uses natural language processing (NLP) and clustering algorithms (i.e., k mean, DBSCAN and dimensionality reduction approaches) to leverage AI to analyze the text of the DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool identifies recurrent and important topics that can be used by an analyst to sift down and further explore potential recurrent safety issues in the DOE operations. | 2022-09-30 | Tony Castellano | <a href="mailto:Tony.Castellano@hq.doe.gov">Tony.Castellano@hq.doe.gov</a> | Commercial-off-the-shelf (COTS) | Yes |
| Data Analytics and Machine Learning (DAML) Tools to enhance the analysis of Environment, Safety and Health (ES&amp;H) data: Unsupervised Machine Learning Text Clustering | U.S. Department of Energy | Office of Environment, Health, Safety &amp; Security | The EHSS Data Analytics Machine Learning (DAML) tools: unsupervised machine learning clustering tool, uses natural language processing (NLP) and clustering algorithms (i.e., k mean, DBSCAN and dimensionality reduction approaches) to leverage AI to analyze the text of the DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool identifies recurrent and important topics that can be used by an analyst to sift down and further explore potential recurrent safety issues in the DOE operations. | 2018-08-01 | Felix Gonzalez | <a href="mailto:felix.gonzalez@hq.doe.gov">felix.gonzalez@hq.doe.gov</a> | Contracted | Yes |
| Data Analytics and Machine Learning (DAML) Tools to enhance the analysis of Environment, Safety and Health (ES&amp;H) data: Unsupervised Machine Learning Text Clustering | U.S. Department of Energy | Office of Environment, Health, Safety &amp; Security | The EHSS Data Analytics Machine Learning (DAML) tools: unsupervised machine learning clustering tool, uses natural language processing (NLP) and clustering algorithms (i.e., k mean, DBSCAN and dimensionality reduction approaches) to leverage AI to analyze the text of the DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool identifies recurrent and important topics that can be used by an analyst to sift down and further explore potential recurrent safety issues in the DOE operations. | 2018-08-01 | Felix Gonzalez | <a href="mailto:felix.gonzalez@hq.doe.gov">felix.gonzalez@hq.doe.gov</a> | Contracted | Yes |
| Data Analytics and Machine Learning (DAML) Tools to enhance the analysis of Environment, Safety and Health (ES&amp;H) data: Unsupervised Machine Learning Text Clustering | U.S. Department of Energy | Office of Environment, Health, Safety &amp; Security | The EHSS Data Analytics Machine Learning (DAML) tools: unsupervised machine learning clustering tool, uses natural language processing (NLP) and clustering algorithms (i.e., k mean, DBSCAN and dimensionality reduction approaches) to leverage AI to analyze the text of the DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool identifies recurrent and important topics that can be used by an analyst to sift down and further explore potential recurrent safety issues in the DOE operations. | 2021-10-01 | Felix Gonzalez | <a href="mailto:felix.gonzalez@hq.doe.gov">felix.gonzalez@hq.doe.gov</a> | Contracted | Yes |
| Data Analytics and Machine Learning (DAML) Tools to enhance the analysis of Environment, Safety and Health (ES&amp;H) data: Unsupervised Machine Learning Text Clustering | U.S. Department of Energy | Office of Environment, Health, Safety &amp; Security | The EHSS Data Analytics Machine Learning (DAML) tools: unsupervised machine learning clustering tool, uses natural language processing (NLP) and clustering algorithms (i.e., k mean, DBSCAN and dimensionality reduction approaches) to leverage AI to analyze the text of the DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool identifies recurrent and important topics that can be used by an analyst to sift down and further explore potential recurrent safety issues in the DOE operations. | 2018-08-01 | Felix Gonzalez | <a href="mailto:felix.gonzalez@hq.doe.gov">felix.gonzalez@hq.doe.gov</a> | Contracted | Yes |
| Data Analytics and Machine Learning (DAML) Tools to enhance the analysis of Environment, Safety and Health (ES&amp;H) data: Unsupervised Machine Learning Text Clustering | U.S. Department of Energy | Office of Environment, Health, Safety &amp; Security | The EHSS Data Analytics Machine Learning (DAML) tools: unsupervised machine learning clustering tool, uses natural language processing (NLP) and clustering algorithms (i.e., k mean, DBSCAN and dimensionality reduction approaches) to leverage AI to analyze the text of the DOE environment, safety, and health (ES&amp;H) and operating experience dataset records (e.g., occurrence reporting and processing system, fire protection, lessons learned, accident and injury reporting system, contractor assurance system CAS). The tool identifies recurrent and important topics that can be used by an analyst to sift down and further explore potential recurrent safety issues in the DOE operations. | 2018-08-01 | Felix Gonzalez | <a href="mailto:felix.gonzalez@hq.doe.gov">felix.gonzalez@hq.doe.gov</a> | Contracted | Yes |
| AI-Based Chat Bot | U.S. Department of Energy | Office of the Chief Information Officer | The O CEO ETIS Service Desk is exploring the ability to use AI chat bots to interact with end-users. We are looking to have a single bot architecture that is highly tuned to IT system languages to properly handle the terms that may be used in an enterprise environment. The primary benefit would be to make knowledge more available to the end-users in a consumable manner. Additionally, it would connect to ITSM workflows that could automate basic functions such as request an account, provide permissions, or create an MS Teams site as an example. Additionally, the technology needs to provide a significant amount of feedback to the ETIS Service Desk on unanswered questions, questions dropped, ineffective responses, incorrect responses, etc. | 2022-09-30 | Tony Castellano | <a href="mailto:Tony.Castellano@hq.doe.gov">Tony.Castellano@hq.doe.gov</a> | Commercial-off-the-shelf (COTS) | Yes |
| Advancing Market-Ready Building Energy Management by using Commercial-off-the-shelf Predictive Control | U.S. Department of Energy | Pacific Northwest National Laboratory | An AI-based differentiable programming framework for domain aware data efficient predictive modeling and AI based control policy synthesis as well as methods for safety verification and online learning. Domain aware deep learning models are used for learning and predicting the response of building systems and components and for optimizing the building energy system response to provide resilient operation and sustained energy efficiency. | 2022-10-01 | Draguna Vrable | <a href="mailto:draguna.vrable@pnnl.gov">draguna.vrable@pnnl.gov</a> | In-house | Yes |
| Adaptive Cyber-Physical Resilience for Building Control Systems | U.S. Department of Energy | Pacific Northwest National Laboratory | Deep learning models are used for predicting the operation of building energy systems, and detecting and diagnosing the health state or cyber attack presence, and for optimizing the building energy system response to provide resilient operation and sustained energy efficiency. | 2020-10-30 | Draguna Vrable | <a href="mailto:draguna.vrable@pnnl.gov">draguna.vrable@pnnl.gov</a> | In-house | Yes |
| Developing Genetic and Environmental Risk Factors for Antipsychotic-induced Metabolic Adverse Effects Using AI | U.S. Department of Energy | Pacific Northwest National Laboratory | Develop AI methods to find phenotypes that capture complex interaction between human genome, chronic diseases and a drug's chemical signature to predict adverse side-effects of a mental health drug on human population | 2023-02-01 | Khushbu Agarwal | <a href="mailto:khushbu.agarwal@pnnl.gov">khushbu.agarwal@pnnl.gov</a> | In-house | Yes |
| APT Analytics | U.S. Department of Energy | Pacific Northwest National Laboratory | Development of A3ML for automated analysis of APT data | 2021-10-01 | Nicole Leahy | <a href="mailto:nicole.leahy@pnnl.gov">nicole.leahy@pnnl.gov</a> | In-house | Yes |</p>
<table>
<thead>
<tr>
<th>Project Title</th>
<th>U.S. Department of Energy</th>
<th>Pacific Northwest National Laboratory</th>
<th>Description</th>
<th>Start Date</th>
<th>End Date</th>
<th>Lead Contact</th>
<th>Contact Email</th>
<th>Type of Work</th>
<th>Access to Data</th>
<th>Research Compliance Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI used for predictive modeling and real-time control of traffic systems</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>Domain-aware deep learning models are used for predictive modeling of traffic. Deep learning based predictive controllers are trained from simulated data to optimize the traffic signal timing and coordination for improved traffic flow and reduced energy consumption and GHG emissions.</td>
<td>2022-09-28</td>
<td></td>
<td>Sonja Glavaski</td>
<td><a href="mailto:sonja.glavaski@pnnl.gov">sonja.glavaski@pnnl.gov</a></td>
<td>Open source, generated from simulated data</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Laboratory Automation</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>Employing machine learning to identify regions of interest in SEM and TEM data. Automating data acquisition to improve efficiencies.</td>
<td>2022-10-10</td>
<td></td>
<td>Nicole Lehtye</td>
<td><a href="mailto:nicole.lehtye@pnnl.gov">nicole.lehtye@pnnl.gov</a></td>
<td>Open source created by simulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Scalable, Efficient and Accelerated Causal Reasoning Operators, Graphs and Spikes for Earth and Embedded Systems (SEA-CROSSES)</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>Establish a center for scalable and efficient physics-informed machine learning for science and engineering that will accelerate modeling, inference, causal reasoning, ecology and pathway discovery for earth systems and embedded systems. Advances will lead to a higher level of abstraction of operator regression to be implemented in next generation neuromorphic computers.</td>
<td>2022-09-15</td>
<td></td>
<td>George Karniadakis</td>
<td><a href="mailto:george_karniadakis@brown.edu">george_karniadakis@brown.edu</a></td>
<td>Open-source, created by simulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Physics-Informed Learning Machines for Multiscale and Multiphysics Problems (PnML)</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>PnML Investigators are developing physics-informed learning machines by encoding physics knowledge into deep learning networks.</td>
<td>2018-10-09</td>
<td></td>
<td>George Karniadakis</td>
<td><a href="mailto:george_karniadakis@brown.edu">george_karniadakis@brown.edu</a></td>
<td>Open-source, created by simulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Managing curb allocation in cities</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>This project’s goal is to develop a city-scale dynamic curb use simulation tool and an open-source curb management platform that address the challenge of increased demand for curb-side parking.</td>
<td>2020-09-02</td>
<td></td>
<td>Naveel Naas</td>
<td><a href="mailto:naveel.naas@pnl.gov">naveel.naas@pnl.gov</a></td>
<td>Open-source created by simulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Regional waste feedstock conversion to biofuel</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>Unsupervised ML is used sequentially to group waste sources into different regions. Calibrated game theoretic models are used to assess the behavior and economic viability of different waste-to-energy pathways within a region.</td>
<td>2022-10-01</td>
<td></td>
<td>Chunhui Li</td>
<td><a href="mailto:chunhui.li@ees.doe.gov">chunhui.li@ees.doe.gov</a></td>
<td>Open-source created by simulations</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>AI techniques for identification of suitable delivery parking spaces in an urban scenario</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>We are using AI (Graph Neural Networks) to determine importance of parking spaces in a city network for curb management to promote adoption of electric vehicles for freight delivery.</td>
<td>2023-01-02</td>
<td></td>
<td>Vinay Amatya</td>
<td><a href="mailto:vinay.amatya@pnnl.gov">vinay.amatya@pnnl.gov</a></td>
<td>Open-source created by simulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Surrogate models for probabilistic Bayesian inference</td>
<td>U.S. Department of Energy</td>
<td>Pacific Northwest National Laboratory</td>
<td>We are using AxiM to build surrogate models of the observable response of complex physical systems. These surrogate models will be used for probabilistic model inversion of these systems with the goal of estimating unknown model parameters from indirect observations.</td>
<td>2022-10-01</td>
<td></td>
<td>David Banjai-Solano</td>
<td><a href="mailto:david.banjai-solano@pnnl.gov">david.banjai-solano@pnnl.gov</a></td>
<td>Open-source created by simulations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Universal MCEG</td>
<td>U.S. Department of Energy</td>
<td>Thomas Jefferson Laboratory</td>
<td>RNA on M-based MC event generator that serves as data compatification utility.</td>
<td>2023-01-02</td>
<td></td>
<td>Malachi Schnier</td>
<td><a href="mailto:schnier@lbl.org">schnier@lbl.org</a></td>
<td>Other Non-Commercial Sources</td>
<td>Data not available at this time. Additional information from Data Science personnel will be provided as soon as possible.</td>
<td>Yes</td>
</tr>
<tr>
<td>FIMS - Invoice BDT - Employee Reimbursements</td>
<td>U.S. Department of Energy</td>
<td>Western Area Power Administration</td>
<td>PROCESS - Invoices are sent to the RPA Invoice BDT email box (<a href="mailto:RPAInvoiceBdt@WAPA.GOV">RPAInvoiceBdt@WAPA.GOV</a>). Once a day, unsent BDT will extract information from PDF invoices. The invoice is classified to determine whether the invoice is an Employee Reimbursement or a Purchase Power Invoice. The information extracted from the invoice is then reviewed submitted by the Accounts Payable Technician. After validation, the bot will load the information into the WAPA Financial Management System.</td>
<td>2021-05-01</td>
<td>2021-10-13</td>
<td>Jonathan Holstein</td>
<td><a href="mailto:jholstein@wapa.gov">jholstein@wapa.gov</a></td>
<td>Contracted</td>
<td>Artificial Intelligence Document Understanding</td>
<td>Financial System Database</td>
</tr>
</tbody>
</table>