Project Title: Artificial Neural Network for MSW Contamination Characterization
Name of Prime Applicant: AMP Robotics Corp

AMP Robotics (AMP), in partnership with Idaho National Laboratory (INL) and Michigan Technological University (MTU), propose development of a real-time, conveyor mounted detection, classification, and sortation system using artificial neural networks (ANNs) to identify contamination within feedstock that can be separated out of municipal solid waste (MSW) and residue from material recovery facilities (MRF) in the form of "whole material contamination" (e.g. metal or glass in a residual paper stream) and "contact contamination" (e.g. remaining film/gunk in or on plastic containers). These materials, otherwise destined for landfills, have the potential to be viable feedstock for pyrolysis. However, the heterogeneity of MSW contamination, and the effects on mechanical preprocessing and pyrolysis yield, challenge the adoption of MSW feedstocks by bioenergy markets.

The project team will leverage the multimodal ANN classification framework developed under DE-FOA-0002203 funding to understand the appropriate sensor suite necessary for contamination detection, and develop an ANN framework capable of detecting and predicting varying levels of contamination in plastics, paper, textiles, organics (wood and yard waste), and metal material categories in MSW feedstock. The ANN classifier inputs will include object, proximate, and ultimate analysis of sourced MSW recorded at INL's Process Development Unit using a variety of sensors, combined with MTU's pyrolysis yield data derived from synthetic and sourced MSW. Lastly, the team will leverage AMP's Secondary Sortation R&D facility to demonstrate a pilot scale, conveyor-based process control of real-time detection, classification, and sortation of MSW and residual MRF material streams.

The aim of AMP/INL/MTU team by the end of this project is most effectively captured in the following objectives:

1. Demonstrate a range of accuracy (between 60% and 90%) of whole material identification for the material types under investigation.
2. Demonstrate an ANN framework capable of predicting contact contamination at >50% to 60% accuracy as compared to the baseline.
3. Demonstrate >25% (min) / >50% (target) improvement of material throughput on a conveyor system (by mass per hour) as compared to baseline while preserving the ANN's whole material identification and contact contamination prediction accuracies.

AMP, INL, and MTU are three leading organizations in the characterization of waste and biomass materials for recovery and energy conversion. AMP Robotics pioneered industrial artificial intelligence and robotic sorting systems for MRFs. INL is the nation's leading laboratory for bioenergy feedstock including improving feedstock preprocessing technologies, understanding feedstock variability and its implications on conversion processes. MTU's Department of Chemical Engineering are experts in bioprocess engineering and the development of bio-based fuels. The University's micro pyrolysis and pilot-scale fast pyrolysis apparti emulate real-world processing. Mr. Mark Baybutt (Managing Director, AMP Robotics) will lead and manage the project. Joining Mark is an outstanding team of Principal Investigators including Dr. Matanya Horowitz from AMP Robotics, INL's Dr. Vicki Thompson, and MTU's Dr. David Shonnard.