All-Digital Plug and Play Passive RFID Sensors for Energy Efficient Building Control
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Team

- **PI**: Prof. Hai Xiao, Electrical Engineering, Clemson, **Sensors and instrumentation**
- **Co-PI**: Prof. Marek Urban, Materials Engineering, Clemson, **Sensor materials**
- **Co-PI**: Prof. Jane Zhao, Mechanical Engineering, Clemson, **Modeling and sensor structure design**
- **Co-PI**: Dr. Jiangdong Deng, Nanofabrication and Characterization, Harvard University, **Sensor device fabrication**
- **Co-PI**: Mr. Richard Pollack, CTO, Phase IV Engineering Inc., Boulder, Colorado; **RFID interrogator**
- **Co-PI**: Mr. Roy White, Director Products and Business Development, Phase IV Engineering Inc., Boulder, Colorado; **Technology transfer and commercialization**
- **Co-PI**: Dr. Xiaohui Zhou, building expert, Iowa Energy Center, **Technology validation towards building control**
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- **Objective:** Plug & play, battery-free, low-cost (<$10 per node) wireless temperature and humidity sensor technology for energy efficient building controls and operations.
  - Buildings are responsible for about 40% of total energy consumption in the U.S. – A great potential for energy saving.
  - Sensors are preferred to be small in size, non-intrusive, wireless and low power, easy to install, long lifespan, and convenient for the retrofit of the old buildings.
  - Existing wireless sensors are costly (~ $100/node), the battery lifetimes are still short, and their integrations into the Building Management System (BMS) are still difficult.
  - Low cost (<$10/node), multi-functions, long lifetime (10 years), and easy integration (e.g., plug & play) into the BMS network could save an average of 3% (0.3 Quads) and up to 8% in overall building energy consumption.
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Technology Solution

- All digital
- Plug & play
- Passive RFID sensors
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Advantage, Differentiation, and Impact

- **All digital** – No signal processing on the sensor node (low cost)
- **Passive** – No on-board battery (long lifetime and low cost)
- **RFID** – Wireless interrogation and plug & play (low cost, many sensors and easy registration/reconfiguration into the BMS)

**Key approaches**

- **Technology development**: design, fabrication, material optimization, interrogation electronics, interface development and laboratory tests
- **Technology demonstration**: validation and demonstration of the novel sensor nodes for building applications at the Iowa Energy Center
- **Tech to market**: partner with a small business company (Phase IV Engineering Inc., very successful experts and entrepreneurship) for tech transfer and commercialization
Thank You

Clemson University, Harvard University, Phase IV Engineering Inc., Iowa Energy Center

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