Current Research Description:

The current state of the gas infrastructure poses many cyber physical challenges. According to ASCE's 2013 report card for America's infrastructure, energy systems are ranked as D+, interpreted as "at risk". These aging systems are in poor condition, with most of their elements reaching the end of their life cycles. Therefore, advanced and efficient systems for control and monitoring of these systems should be a high priority. Currently, natural gas infrastructure at the distribution level is not subject to frequent maintenance and monitoring.

Enhancing the maintenance and control of gas pipeline infrastructure is of great importance since leak incidents instigate great safety and environmental issues. Many studies, have addressed the importance of obtaining better emission and leakage data to alleviate the climate footprint of natural gas infrastructure, prioritize industrial decision-making processes, and risk-informed policies.

In addition to environmental impacts regarding methane emissions, natural gas distribution in populated urban areas requires significant safety measures. Real time monitoring and control of gas pipelines, can provide detailed information of leakages and their location and therefore enhance the safety and integrity of the system, while deterring the environmental impacts.

On the other hand, accurate and frequent condition information can provide synergy opportunities for utility companies to optimize their maintenance schedules and minimize their operation cost. Maintenance of services such as gas pipelines, electricity cables, telecommunication fibers, and water pipelines requires excavation and traffic disruptions. Leverage of infrastructure condition information would prioritize risk-informed decisions and provide opportunities for different utility companies to minimize their excavation cost and impact on users by syncing their schedules.

Lastly, a sophisticated yet feasible and cost-effective control system can provide feedback to utility companies and costumers by analysis of consumption patterns. In one end, this feedback would help consumers to make effective decisions about their gas-based appliances. On the other end, it would help utility companies to optimize their peak shaving and storage strategies while ensuring that costumer would receive their demand in a timely manner.

My research aims to utilize novel sensing techniques and advanced statistical modeling to mitigate the environmental impacts of aging natural gas infrastructure and provide optimal strategies for health monitoring of the natural gas networks.