U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Clean. Reliable. Nuclear.

Advanced Online Monitoring and Diagnostic Technologies for Nuclear Plant Management Operation, and Maintenance

Advanced Sensors and Instrumentation Annual Webinar

October 29, November 5, November 12 , 2020

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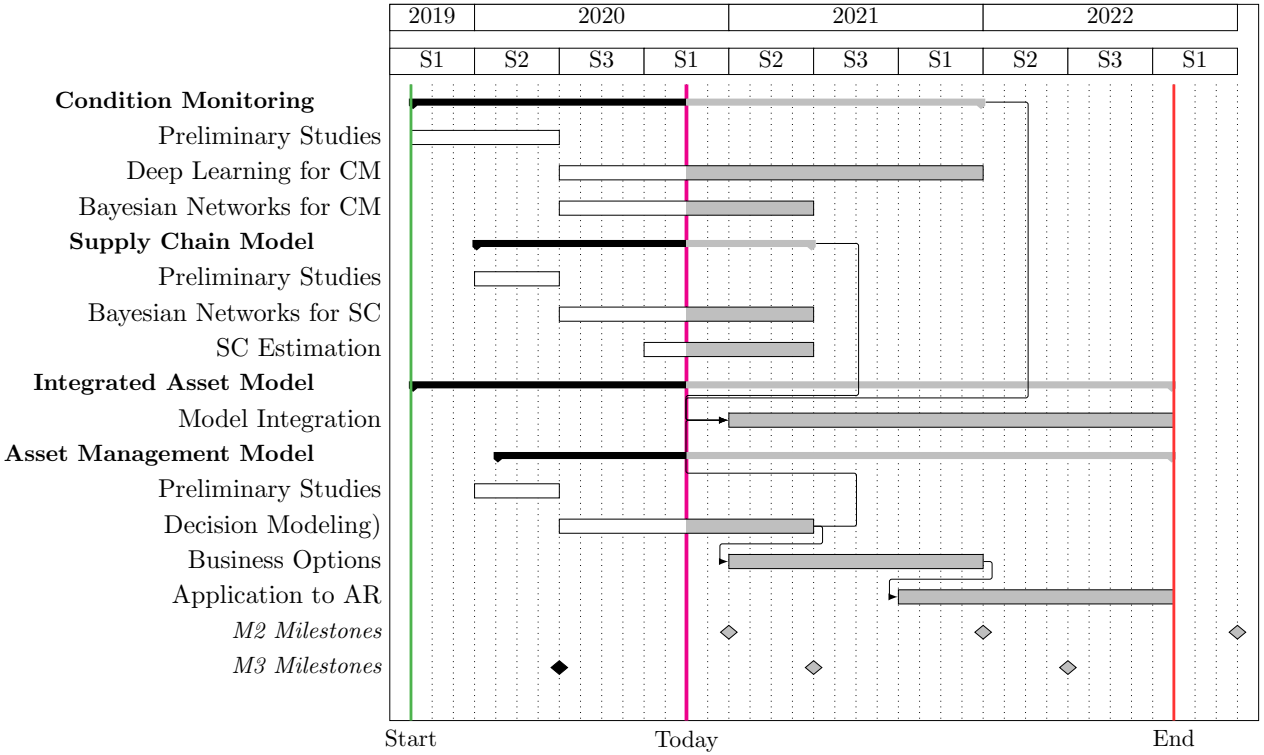
Project Overview

Goal: To develop and demonstrate advanced online monitoring to better manage nuclear plant assets, operation, and maintenance.

Daniel Cole (Pitt)

Heng Ban (Pitt)

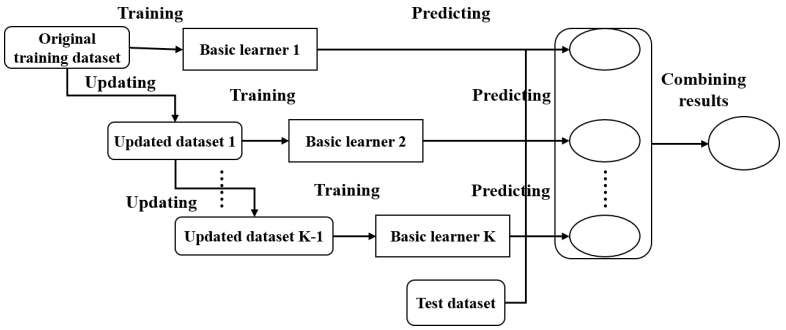
Vivek Agarwal (INL)



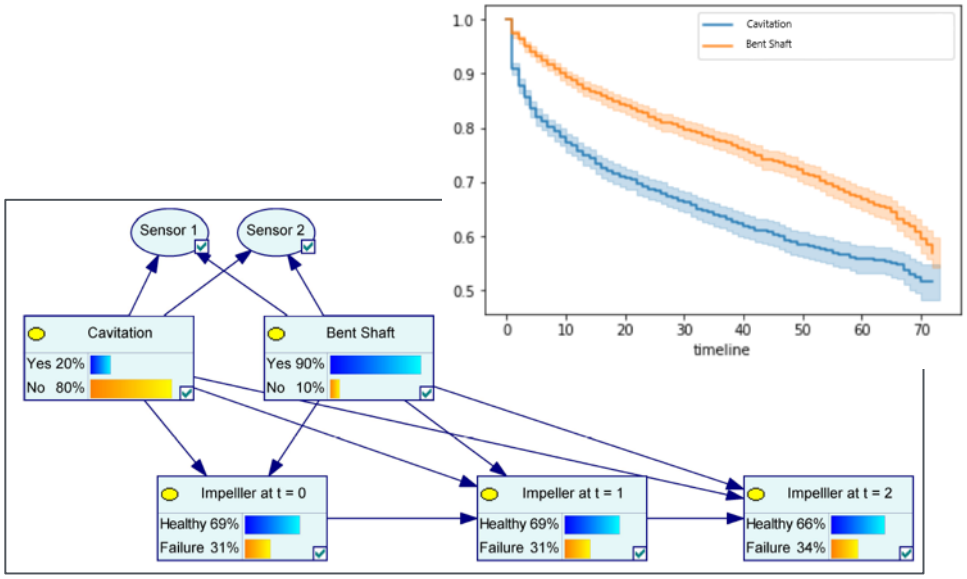
Summary of accomplishments

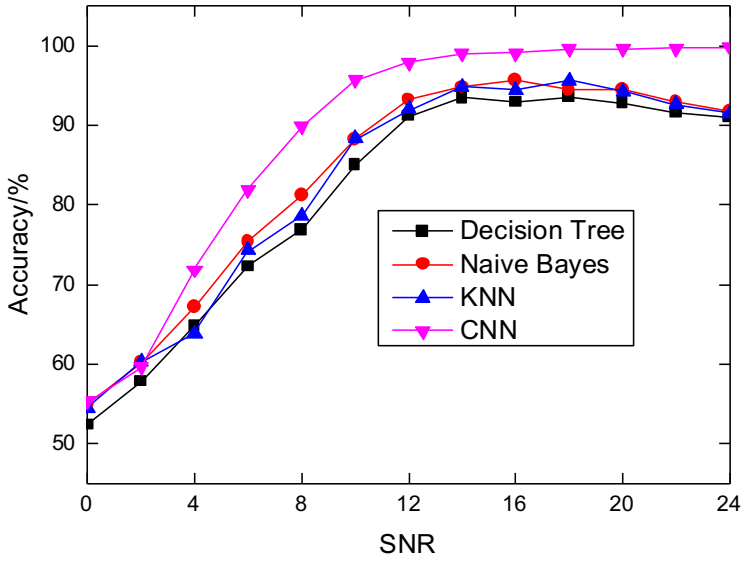
Condition Monitoring

- We have evaluated ensemble learning methods to improve classifiers
- Evaluation of convolutional neural networks for condition monitoring
- We are developing hazard models and survival analysis to forecast degradation and estimate life



Boosting method

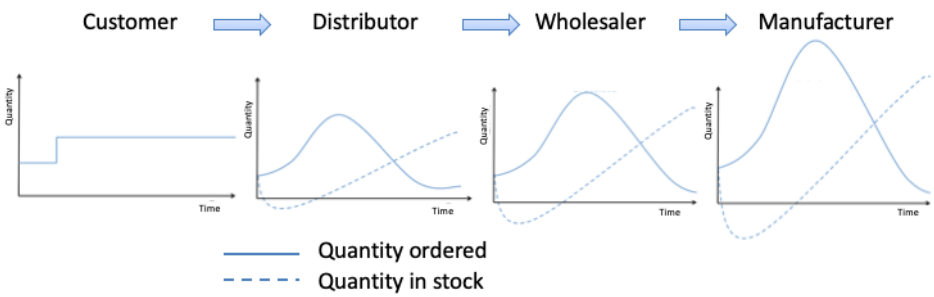


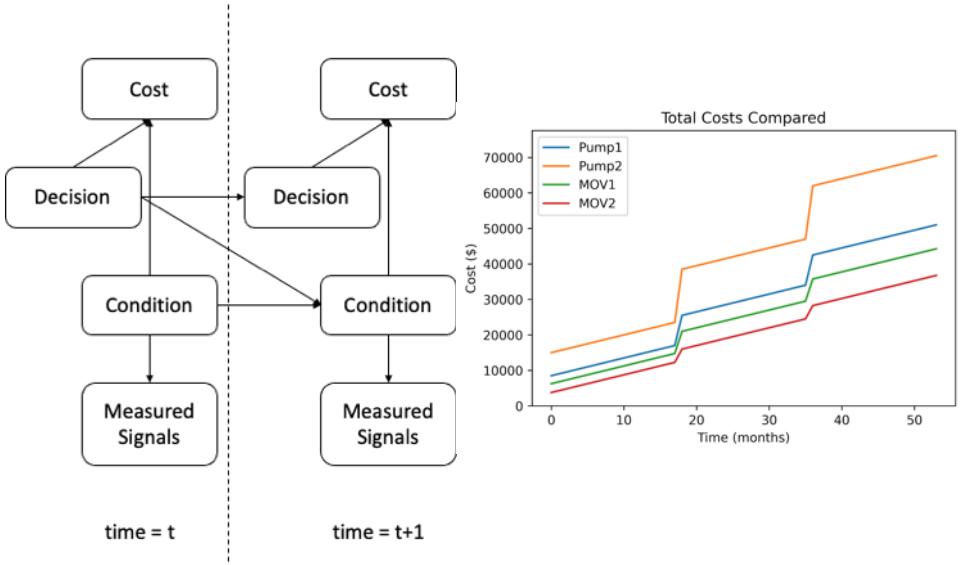


Summary of accomplishments

Supply Chain

- We have simulated resource availability and are creating Bayesian statistical estimation techniques from the simulated data
- We are creating dynamic supply chain models that account for uncertainties and can be used for estimating up-stream supply





Decision Making

- We are developing decision-making tools to account for uncertainties when evaluating O&M options, including performance over multiple outages
- The development of object-oriented decision-making network to analyze integrated decision over multiple components and outages.

Technology Impact

This research provides an integrated approach for long-term decision-making for plant operation

Utilities would be better able to manage plant O&M

Minimize staffing levels with real financial impact.

The asset management analysis will support decision-making for

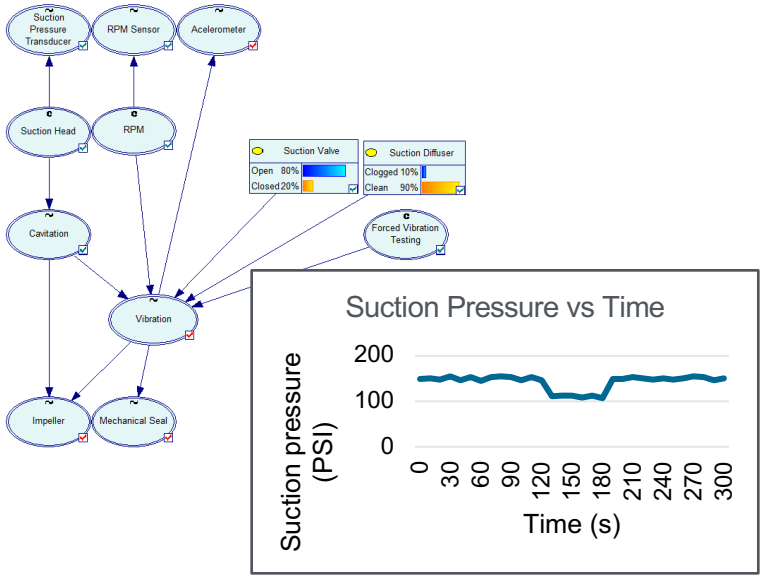
- **SSC replacement and asset management**
- **supply chain, resource availability, and outage planning**
- **license extension for long-term operation**

By better accounting for obsolescence and replacement in financial decision-making, utilities can optimize costs.

The proposed technology can be applied to different reactor designs or fuel cycle applications.

Accomplishments (1/3)

We can include operational incidents in the condition monitoring process



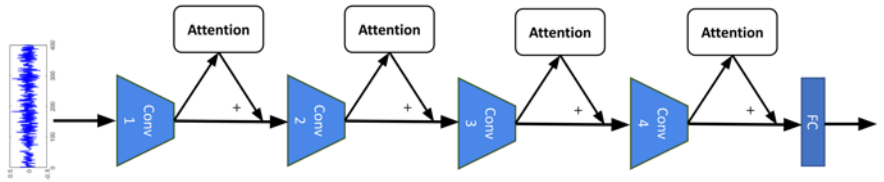
Seismic Test Report

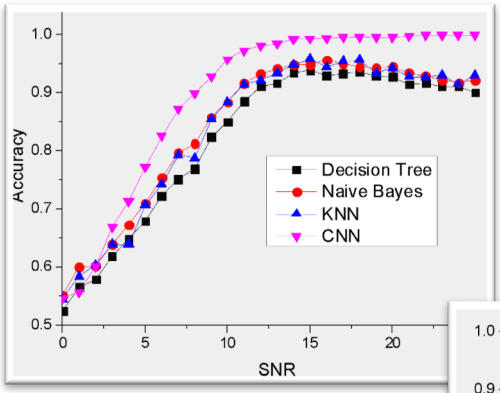
Recent test caused random vibration excitations to propagate through the plant.

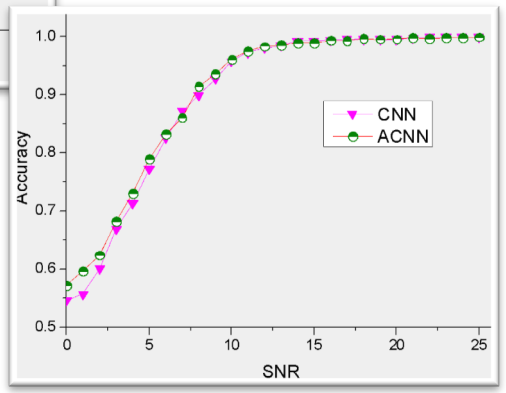
Suction Diffuser Maintenance Report

Diffuser was recently cleaned and a new filter was installed.

Deep learning improves fault diagnosis of plant equipment

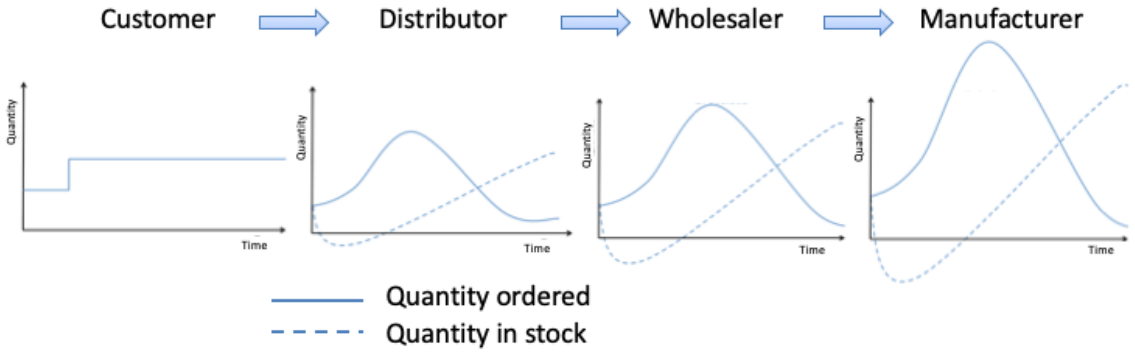


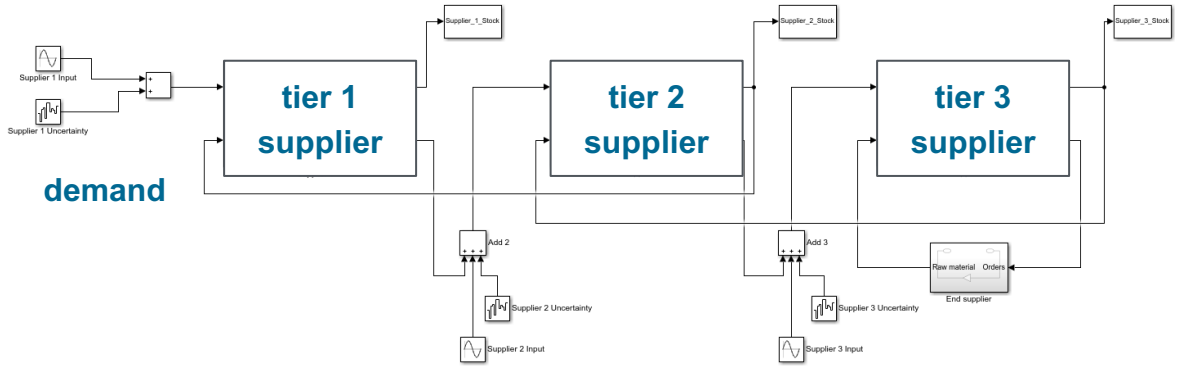


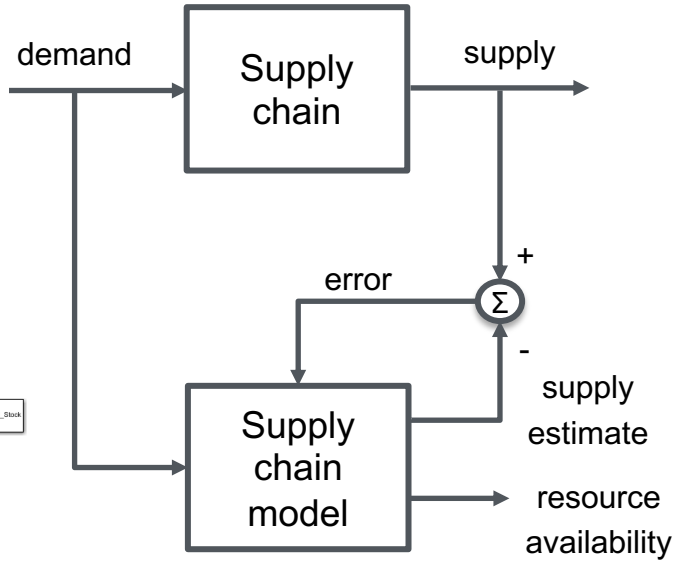


Accomplishments (2/3)

Resource uncertainty can occur when a change in demand causes fluctuations of inventory up the supply chain.

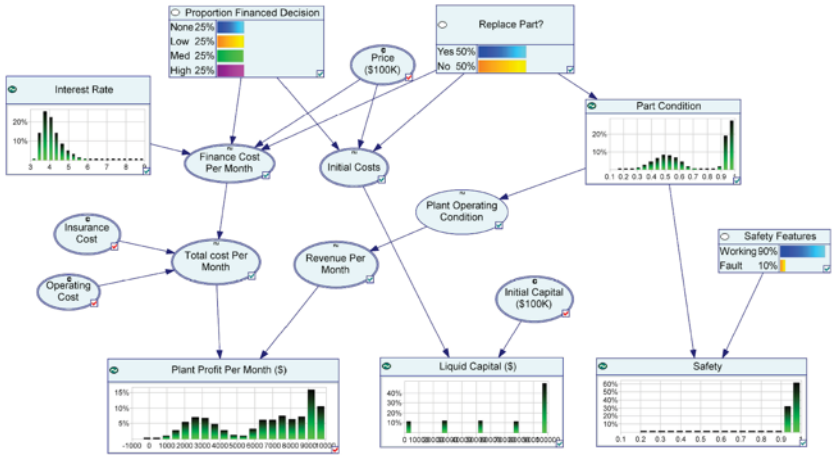


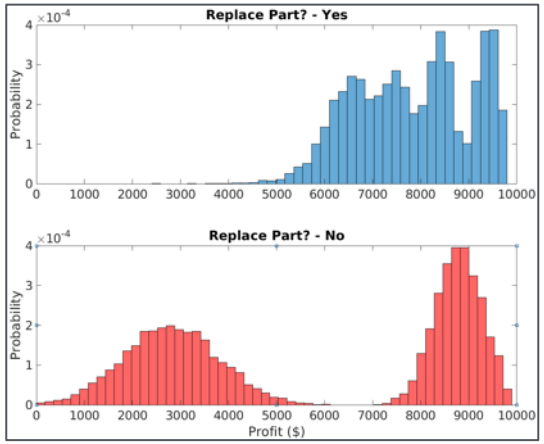


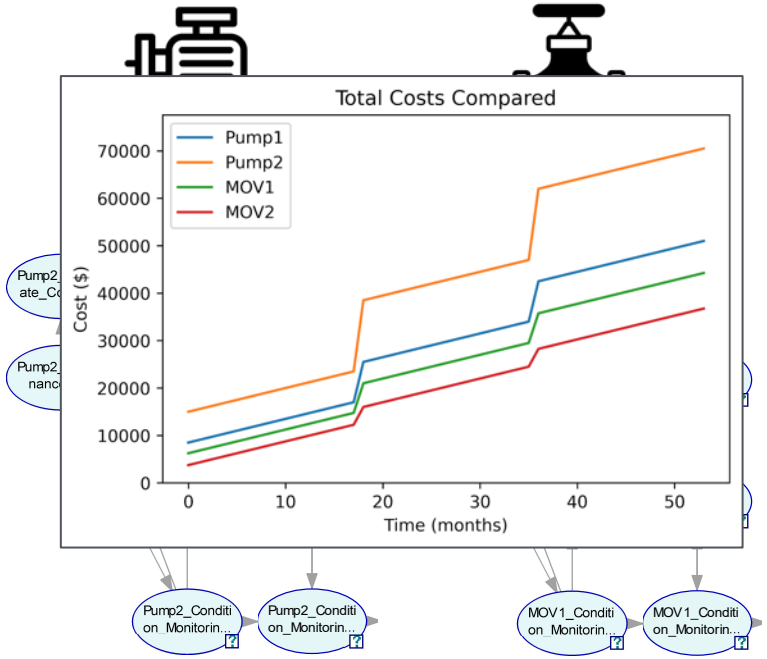


Accomplishments (3/3)

We are developing decision-making networks to analyze integrated decision over multiple components and outages







Conclusion

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Condition Monitoring

- **We have evaluated various machine learning methods for improving classification and condition monitoring**

Supply Chain

- **We are creating dynamic supply chain models that can be used to estimate up-stream supply and resource availability.**

Decision Making

- **We are developing decision-making tools to analyze integrated decision over multiple components and outages.**