Artificial Intelligence for Robust Engineering & Science

AIRES 2: Machine Learning for Robust Digital Twins

Virtual Workshop
January 19-21, 2021

Overview

Robust engineering is the process of designing, building, and controlling systems to avoid or mitigate failures. The introductory Artificial Intelligence for Robust Engineering and Science (AIRES) workshop in January 2020 explored these foundations. This second AIRES workshop will build on the success of the first workshop to explore and develop the foundations of AI for constructing, deploying, and assuring the robustness of digital twins. The workshop will comprise three tracks:

Construction of digital twins. This track will explore the mathematical and computational aspects of using machine learning to construct robust models of physical systems with an emphasis on dynamical and complex systems. Topics of interest include but are not limited to
- Feature engineering and knowledge representation
- Integrating time-series data for anomaly detection and trends predictions
- Incorporating physics-based prior information
- Developing an evolving digital twin through continuous learning
- Data management

Application and deployment of digital twins. This track focuses on the practical challenges when using digital twins, such as
- Edge deployment for real-time and power-efficient deployment of digital twins
- Federated learning for privacy or for data reduction
- Integrating HPC and edge systems, including model and data management
- Online and offline continuous learning on edge-based systems
- Human-machine interface design

Techniques to provide assurance. This track will address issues of assuring that the digital twin is appropriately designed, constructed, and deployed with a level or rigor that is consistent with the intended use, including the level of risk. Assurance should be broadly interpreted to include
- Verification, validation, and calibration
- Security and resilience
- Uncertainty quantification (UQ)
- Causal inference
- Detecting and dealing with bias
- Explainability and interpretability

Meeting format

AIRES 2 will be held virtually from January 19-21, 2021. The workshop will comprise nine sessions, with two sessions dedicated to each track. Additional breakout sessions will be used for small-group interactions and brainstorming activities. A workshop report will be produced with input from attendees based on participation in breakout and brainstorming sessions.

AIRES 2 is focused on user participation with the objectives of exploring current work in the use of machine learning for robust engineering and digital twins, identifying research challenges and investment areas, and developing collaborations among participants. The workshop will include
- *Invited talks* by leaders in the field.
- *Contributed talks* by participants (15 minutes each). Participants may propose a talk during the registration process. The program committee will select 20 for presentation during the workshop.
- *Breakout sessions* to address specific questions proposed by the program committee and by participants. A summary of each breakout session will be included in the workshop report. Participants who wish to lead a breakout session may propose a topic during the registration process.

How to participate

With the goal of increased collaborations, AIRES 2 participants will be expected to actively contribute in the workshop including small group interactions and breakout sessions. In addition to providing basic personal and contact information during registration, participants will also provide their research interests and be given the option to propose a contributed 15-minute talk, recommend breakout session topics, and volunteer to lead a breakout session. Registration is free.

Participation is by invitation only. Requests to participate can be emailed to AIRES@ornl.gov. The deadline to request an invitation is December 31, 2020.

Meeting organization

AIRES 2 will be hosted by Oak Ridge National Laboratory.

General Chair:
David Womble, Oak Ridge National Laboratory

Logistics and Planning Chair:
Christy Hembree, Oak Ridge National Laboratory

Organizing Committee:

Iris Bahar, Brown University

Kevin Cao, Arizona State University

Frank Liu, Oak Ridge National Laboratory

Dan Lu, Oak Ridge National Laboratory

Justin Newcomer, Sandia National Laboratories

Laura Pullum, Oak Ridge National Laboratory

Pradeep Ramuhalli, Oak Ridge National Laboratory

Abhinav Saxena, GE Global Research

Malachi Schram, Pacific Northwest National Laboratory

Sudip Seal, Oak Ridge National Laboratory

Dali Wang, Oak Ridge National Laboratory

For more information, please visit https://AIRE.ORNL.gov.