NAFEMS americas events

The International Association for the Engineering Modeling, Analysis and Simulation Community

Conference Abstracts

AI, Data Driven Models & Machine Learning:

How Will Advanced Technologies Shape Future Simulation Processes?

February 23rd-24th, 2022 / Online

nafems.org/americas

Sponsored by

HEXAGON | MSC Software | SIMULIA | NEURAL CONCEPT

Front End Analytics Delivering Business Advantage | MONOLITH | DATADVANCE

In-Kind Sponsor

ASSESS

Contact Information

NAFEMS Americas
130 N Prospect Street, Suite K
Granville, OH 43023
Tel. 1.614.360.1922
Fax. 1.740.587.1505
americas@nafems.org

Presenter Name: Uyiosa Abusomwan

Presenter Company: Rice University

Presentation Title: I4.0 Product Engineering & the Role of AI in the Future of Product Development

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

Presenter Name: Ankit Agrawal

Presenter Company: Northwestern University

Presentation Title: AI-Driven Learning of the Science and Engineering of Materials from Simulations

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

The increasing availability of data from the first three paradigms of science (experiments, theory, and simulations), along with advances in artificial intelligence and machine learning (AI/ML) techniques has offered unprecedented opportunities for data-driven science and discovery, which is the fourth paradigm of science. Within the arena of AI/ML, deep learning (DL) has emerged as a transformative technology in recent years with its ability to effectively work on raw big data, bypassing the (otherwise crucial) manual feature engineering step traditionally required for building accurate ML models, thus enabling numerous real-world applications, such as autonomous driving. In this talk, I will present some of the ongoing AI/ML/DL research in our group to learn the forward and inverse processing-structure-property-performance (PSPP) relationships in material systems using data from a variety of simulations -- such as density functional theory (DFT), finite element method (FEM), discrete dislocation dynamics (DDD), and rigorous coupled wave analysis (RCWA). We will also briefly discuss how AI models trained on simulations can be adapted for experimental data.

Presenter Name: Juan Betts

Presenter Company: Front End Analytics LLC

Presentation Title: New Developments in Physics Informed Machine Learning & Artificial Intelligence

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

Over the past three years the field of Physics Informed Machine Learning (PIML) and Artificial Intelligence (AI) has experienced a dramatic renaissance. New methods for integrating physics based principles into ML are being developed redefining what problems can be solved with PIML & AI. PIML & AI is revolutionizing applications such as predictive maintenance, electrification & autonomy, and even the discovery of new drugs to treat disease. This paper describes some of the emerging methods and trends shaping this exciting new field.

Presenter Name: Zhenyuan Gao

Presenter Company: Dassault Systemes Simulia Corp

Presentation Title: Neural Network Approaches for Plastic Material Modeling

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

Neural network approaches have been widely applied to constitutive modeling of elastoplastic materials, due to their ability to calibrate a large number of parameters and to approximate arbitrary mathematical equations. Some neural network approaches (e.g., recurrent neural network) can also be used to approximate history-dependent behavior. Given that material model calibration usually requires engineering expertise, neural network approaches offer an intriguing alternative. In this work, different neural network and hybrid approaches are utilized to model isotropic and anisotropic plastic materials. The feasibility to implement such methods into finite element analysis is evaluated. Focus is placed on adapting the existing methods to different material behavior and structural problems. Benchmark results show that the present models and methods can adequately predict different plasticity behavior.

Presenter Name: Rani Harb

Presenter Company: MSC Software Corporation

Presentation Title: Hybrid Approach Combining Machine Learning and Meta-Modeling to Predict Material Behavior

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords: machine learning, material data, meta-modeling, digital twin, virtual material engineering

Abstract:

In today's highly competitive industrial landscape, we witness a pervasive economic pressure to constantly innovate and bring forward novel solutions at a faster rate. In the field of materials and ICME, there is a strong interconnection between manufacturing processes, environmental conditions and the underlying microstructure that drives the part performance. Understanding these connections would require exhaustive testing and trial-and-error, which are set against the current pressure to rapidly innovate and shrink development times. To this point, physical testing covering a broad spectrum of environmental scenarios and material conditions (temperature, strain rates, fiber content, additives, etc.) can be dauntingly large and impractical to cover exhaustively, leaving material suppliers and other OEMs to reluctantly accept large "voids" in the design space. As such, we propose a hybrid workflow based on data analytics, machine learning and meta-modeling in order to build and predict highly reliable virtual results for a broad spectrum of temperatures, strain rates, humidity contents, material types, etc. These results can also be used to construct material models able to predict part performance under given test conditions with requisite accuracy.

Presenter Name: Nikita Jaipuria

Presenter Company: Ford Motor Company

Presentation Title: Photorealistic Synthetic Data Generation For AI-Based Feature Development

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords: Generative Adversarial Networks, data augmentation, style transfer, automated driving

Abstract:

AI feature development for automated driving applications is heavily reliant on large quantities of diverse data. Generative Adversarial Networks (GANs) are now widely used for photo-realistic image synthesis. However, in applications where a simulated image needs to be translated into a realistic image (sim-to-real), GANs trained on unpaired data from the two domains are susceptible to failure in semantic content retention as the image is translated from one domain to the other. This failure mode is more pronounced in cases where the real data lacks content diversity, resulting in a content mismatch between the two domains - a situation often encountered in real-world deployment. This presentation will discuss the role of the discriminator's receptive field in GANs for unsupervised image-to-image translation with mismatched data, and study its effect on semantic content retention. The presentation will also show how targeted synthetic data augmentation - combining the benefits of gaming engine simulations and sim-to-real GANs - can help fill gaps in static datasets for vision tasks such as parking slot detection, lane detection and monocular depth estimation. Prior knowledge in computer vision and deep learning will be helpful in getting the most out of this session.

Presenter Name: Xun Jiao

Presenter Company: Villanova University

Presentation Title: Machine Learning-based Timing Error Simulation of Microelectronic Circuits

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

As the transistor size scales down to deep nanometer era, microelectronic circuits are increasingly susceptible to microelectronic variations. The most immediate manifestation of such variations is the delay uncertainty which can prevent circuits from meeting their timing specification, resulting in timing errors. Without proper protection, such timing errors can pose great threats to the reliability of digital systems. While gate-level simulation can accurately simulate circuit timing errors, it is often prohibitively slow and could require expensive licensing fee to access commercial simulation tools. In this talk, I will present our work in using machine learning methods to build predictive models that can classify the timing errors of circuits under different operating conditions, clock speeds, and input workload. Our model is able to achieve an average classification accuracy above 95% and is 50-100X faster than gate-level simulation. The promising results can potentially lead to a novel path in using machine learning to complement or replace simulation tools in electronic design automation.

Presenter Name: NAFEMS Engineering Data Science Working Group

Presenter Company:

Presentation Title: Panel Discussion: Current and Emerging Machine Learning Techniques for Engineering Applications

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

Presenter Name: Thomas Von Tschammer

Presenter Company: Neural Concept Ltd.

Presentation Title: Reducing CAE Costs and Lead Time Thanks to Deep-Learning in CAD/CAE

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

Presenter Name: Sergey Morozov

Presenter Company: DATADVANCE

Presentation Title: How to Develop and Deploy Hybrid (sim/ML) Models at Scale

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords:

Abstract:

True value of simulation or machine learning models or even hybrid simulation and ML models can only be uncovered if they are developed and deployed at the scale of the whole design office and even whole enterprise. Traditional approach would require an army of skillful simulation engineers and data scientists, - digital transformation superheroes. Low-code coupled with smart ML algorithms is an efficient approach to democratize development, deployment and management of sim/ML models at scale. In this talk we will demonstrate how it works on a set of industrial use cases.

Presenter Name: Richard Ahlfeld

Presenter Company: Monolith AI

Presentation Title: Accelerating Manufacturability Processes Using PINNs

Location: TBC

Presentation Date & Time (EST; New York): TBC

Keywords: AI, Engineering, Simulation, Manufacturability, Surrogate Modelling

Abstract:

Design optimization and identifying critical regions in a design fast is one of the primary objectives for the manufacturability of a new product. Each iteration using classical CAE methods can come with an enormous effort in time and cost. One major obstacle of using classic design optimization algorithms are speed and lack of important input and output information for critical applications. The traditional CAE approach often forces engineers to run multiple parametric studies for new designs which not only creates huge data lakes but also makes this process very costly and tedious especially because the simulation must be re-run each time an engineer makes a change. Surrogate models leveraged by Monolith AI can help overcome on-premise hardware restrictions and exploit raw data using them for training and getting new key insights from seemingly irrelevant old data lakes. This gives users an easy to interpret output such as the manufacturability of a component by learning from complex input data and mapping them to surface fields in an unparalleled fast manner and fewer simulations that need to be run in the long run. This patent-pending approach works on all types of meshes and has proven to be very efficient when varying the geometry and mapping tested conditions to geometries which have not be seen in training.