Graduate Student Research Seminar

Spring 2025

Solving Interoperability for Digital Twins

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3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

A lack of interoperability is one of the major factors inhibiting digital twins from being used in general industry. Digital twins are nearly always insular creations: composed of bespoke models in siloed platforms. We provide an alternative formalism for reconstructing otherwise sequestered models into a single, unified system model. This mathematical structure is graphical in nature; nodes represent the identifiable states of a system, and edges represent their relationships as functional constraints. This reduces a system to a collection of independent, set-based functions whose arrangement describes the emergent behavior of the system. Several interesting results develop from this. First, the composability of functions guarantees that models can interface with other models without contradiction, allowing digital twins to be formed by model aggregation. Second, universal simulation of the system can be conducted using simple pathfinding strategies, exposing all modeled information about the represented system to an interfacing agent. Applications to digital twins are demonstrated by integrating information from often disparate domains such as discrete-event simulations, controller protocols, relational databases, dynamic models, and CAD tools. In each case, the framework expands the ability for digital twins to communicate information about the real-world systems they represent.

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