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CONTINUUM SEMICONDUCTOR PHYSICS MODEL COMPRESSION VIA DATA-DRIVEN DISCRETE EXTERIOR CALCULUS

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Abstract.

High-fidelity partial differential equations (PDE) based continuum models of physical conservation laws are a standard tool in research and engineering. Often, it becomes necessary to produce reduced-order models of these same physical systems in order to explore large parameter spaces, couple hierarchies of models, and etc. In this talk, we will present our method for producing machine-learned reduced order models formulated using the mechanism of Datadriven Discrete Exterior Calculus (DDEC), trained on high-fidelity PDE physics data and in which the natural expression of physical conservation laws can be embedded in the machine learning architecture [4],[2].

As an example, we will focus on a semiconductor physics continuum PDE model involving the drift-diffusion equations for electron and hole transport coupled with the Poisson equation for the electric potential. We will present a spectral graph coarsening method [3],[1] which is applied to the high-fidelity PDE-based simulation data from which a DDEC model is obtained and trained to reproduce the application-relevant data of the model. In this case, voltages are applied at boundary contacts of a semiconductor device which induce current flow through those contacts; the DDEC model captures the mapping of these input voltages to the corresponding output currents while respecting the conservation laws of the PDE based model.

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