Computational Mechanics Group
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Topic proposal

Mechanics with AI

Leveraging advances in machine learning for solving scientific problems has been a key thrust of research in recent years. Mechanics problems ranging from microscale to continuum scale modeling and simulation to mechanical properties estimation, uncertainty quantification, structure and process optimization have been shown to benefit from these novel approaches. However, developing robust machine learning methods to tackle these problems remains a challenge.
In our group, we use machine learning approaches with varied degree of data requirements to solve mechanics problems. One proposed project is aimed at solving governing parameterized partial differential equations (PDEs) for phase-field fracture, a promising approach to model all the fracture processes including crack nucleation, propagation and branching in a unified way, using physics-informed neural networks (PINNs). Solution to this problem is guided by physics and minimal or no data is required. The second proposed project aims to accurately predict the quality of additively manufactured parts from process parameters and part geometry, and help optimize the process. Since the high fidelity simulations of the process are prohibitively expensive, a reliable surrogate model is needed. This project will combine some physics with data from high-fidelity simulations and experiments to develop a machine learning model. Please contact us if you would like to pursue one of these directions for your project and we can discuss them in more detail.

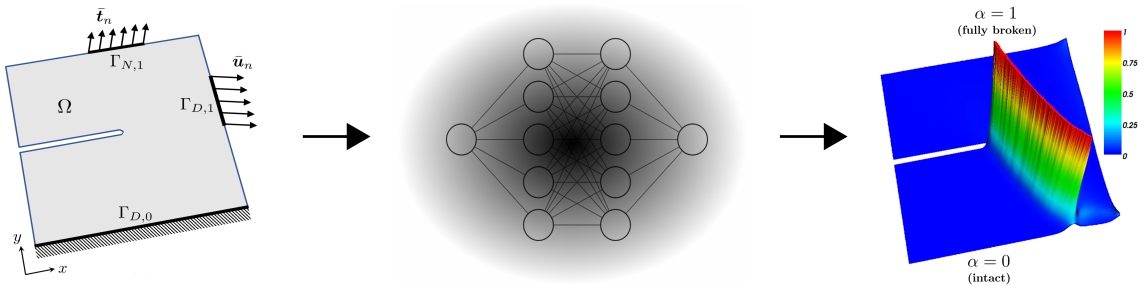

Figure: A cleverly designed “translucent” box solving mechanics problems

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