Mechanistic Data Science for STEM Education and Applications

Wing Kam Liu, Zhengtao Gan, Mark Fleming

Springer International Publishing, Nov 21, 2021 - Technology & Engineering - 295 pages

This book introduces Mechanistic Data Science (MDS) as a structured methodology for combining data science tools with mathematical scientific principles (i.e., "mechanistic" principles) to solve intractable problems. Traditional data science methodologies require copious quantities of data to show a reliable pattern, but the amount of required data can be greatly reduced by considering the mathematical science principles. MDS is presented here in six easy-to-follow modules: 1) Multimodal data generation and collection, 2) extraction of mechanistic features, 3) knowledge-driven dimension reduction, 4) reduced order surrogate models, 5) deep learning for regression and classification, and 6) system and design. These data science and mechanistic analysis steps are presented in an intuitive manner that emphasizes practical concepts for solving engineering problems as well as real-life problems. This book is written in a spectral style and is ideal as an entry level textbook for engineering and data science undergraduate and graduate students, practicing scientists and engineers, as well as STEM (Science, Technology, Engineering, Mathematics) high school students and teachers.

Website: https://mechanistic-data-science.mech.northwestern.edu

US link to the textbook: https://www.springer.com/us/book/9783030878313#aboutBook

EU link to the textbook: https://www.springer.com/gp/book/9783030878313

Northwestern | ENGINEERING