

Civil and Environmental Engineering Seminar

The Astani Department of Civil & Environmental Engineering presents



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Professor in Civil and
Environmental Engineering at
University of California, Davis

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Time: 12:30 – 1:30 PM
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Zoom Meeting:
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Physics-informed data analytics approaches using constrained optimization - exploiting domain knowledge and hard information in a transportation network

Abstract: Civil infrastructure as a system often faces challenges and complexity brought by interactions between spatially- and functionally- distributed components. Recognizing and incorporating these physical interactions in data driven approaches present challenges but also unique research opportunities for domain experts. In this talk, I will use transportation networks as examples to discuss how constrained optimization, by providing a flexible modeling framework for integrating domain knowledge, statistics, and data-driven approaches, could help addressing some fundamental data challenges that frequently arise in transportation applications. The first example shows how stochastic programming (SP) can be used to provide a statistically consistent and efficient estimate of global variables (network-level travel demand) that are not directly measurable based on partial local measurements (link-level traffic flows). In this example, domain knowledge reflecting network physics is modeled explicitly as constraints, and data samples are treated in some sense as uncertain scenarios in a SP framework. The second example shows how domain knowledge regarding the usage of data may be directly incorporated in data compression to support end-to-end learning. In this example, objectives of the downstream application may be included in the design of the loss function in the data dimension reduction process. The results demonstrate the importance of application-aware data compression approaches for networked data.

Bio: Yueyue Fan is a professor in Civil and Environmental Engineering at University of California, Davis. She is also a faculty member in the graduate program of Applied Mathematics at UC Davis. She received her PhD in Civil Engineering at University of Southern California in 2003. Dr. Fan's research is on transportation and energy infrastructure systems modeling, with a special interest in integrating applied mathematics and engineering domain knowledge to address fundamental challenges brought by data and system uncertainty, dynamics, and underdetermined issues. Dr. Fan is currently serving as the program director of the Civil Infrastructure Systems (CIS) program at the National Science Foundation.