Mechanical Engineering Seminar

Monday, November 25, 2024 at 14:30

Online: https://mit.zoom.us/j/93921883036

Less is more: Rethinking One-Shot Learning

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The statistical supervised learning framework assumes an input-output set with a joint probability distribution that is reliably represented by the training dataset. The learner is then required to output a prediction rule learned from the training dataset. Unfortunately, most supervised learning-based methods are highly demanding in terms of computational resources and training data (sample complexity). Moreover, trained models are sensitive to domain changes, such as varying acquisition systems, signal sampling rates, resolution and contrast. In this talk, I will try to answer a fundamental question: Can supervised learning models generalize well solely by learning from a single training example? To this end, I focus on an efficient patch-based learning framework that requires only a single image input-output pair for training. The experimental results demonstrate the applicability, robustness and computational efficiency of the proposed approach for image restoration tasks across different fields: seismic imaging, medical image denoising, and low-level vision tasks. I will also present meaningful theoretical insights into the information-theoretic asymptotic equipartition property (AEP) (Shannon,1948) in the context of machine learning, and illuminate some of its potential effects on few-shot learning. I will show theoretical guarantees for reliable learning under the AEP, and for the generalization error with respect to the sample size. As adaptation of supervised learning models to unseen domains remains a challenging problem, I will briefly discuss domain-awareness in the context of these applications. The results showcase significant improvement of learning models' sample efficiency, generalization and time complexity, that can hopefully inspire future deployment of the proposed learning perspective to future real-time applications and be applied to other signals and modalities.

Deborah Pereg has recently completed her postdoctoral training with MIT and Harvard.
She received the M.Sc. and Ph.D. degrees in Electrical and Computer Engineering from the Technion - Israel Institute of Technology, in 2021 and 2017 respectively. Her main research interests are signal processing and machine learning, in particular inverse problems and sparse representations.

Seminars Coordinator: Assoc. Prof. Gal Shmuel