המכללה האקדמית להנדסה בתל-אביב
אפקה
הנדסה גבוהה

Exact Sciences Seminar
Monday 09.03.20 Monday on 16:00-17:00, Ficus 303

Dr. Leah Bar
MaxQ-AI and Tel-Aviv University

Learning-Based Strong Solutions to Forward and Inverse Problems in Partial Differential Equations

Abstract

We introduce a novel neural network-based partial differential equations solver for forward and inverse problems. The solver is grid free,
mesh free and shape free, and the solution is approximated by a neural network.
We employ an unsupervised approach such that the input to the network is a points set in an arbitrary domain, and the output is the
set of the corresponding function values. The network is trained to minimize deviations of the learned function from the PDE solution and satisfy the boundary conditions.
The resulting solution in turn is an explicit smooth differentiable function with a known analytical form.Unlike other numerical methods such as finite differences and finite elements, the derivatives of the desired function can be analytically calculated to any order. This framework therefore, enables the solution of high order non-linear PDEs. The proposed algorithm is a unified formulation of both forward and inverse problems where the optimized loss function consists of few elements: fidelity terms of L2 and L infinity norms, boundary and initial conditions constraints, and additional regularizers. This setting is flexible in the sense that regularizers can be tailored to specific problems. We demonstrate our method on several free shape 2D second order systems with application to Electrical Impedance Tomography (EIT), diffusion and wave equations.

Coordinators: Dr. G. Ben-Simon, Prof. D. Fishelov,
Prof. I Goldman, Dr. Alex Segal

Afeka Tel Aviv Academic College of Engineering, 38 Mivza Kadesh St., Tel Aviv