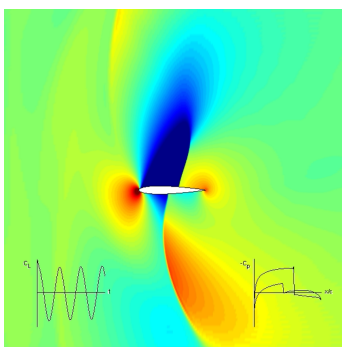
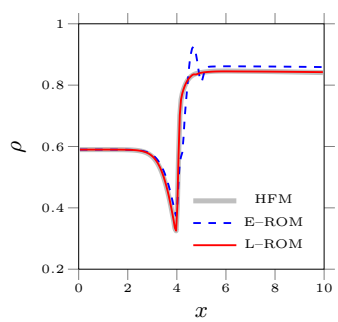
Project Title: Deforming Mesh Method for Dimensionality Reduction of Compressible Fluid Flows

Advisor: Prof. Maciej Balajewicz (AE)

Project Description: Accurate and efficient high-fidelity simulations are critical to many energy, defense, and health applications, e.g., global climate simulations, optimal design of wind systems for power generation, combustion simulations aimed at increasing fuel efficiency and reducing carbon emissions, simulations of heart fibrillation, and many others. Unfortunately, even with the aid of massively parallel next-generation computers, high-fidelity simulations are still too expensive for real-time and multi-query applications such as uncertainty quantification, design, optimization, and control. We have recently developed a new dimensionality reduction approach that promises to significantly reduce computational costs while retaining the accurate of the original high-fidelity model. An undergraduate research assistant will be working on implementing a MATLAB optimization algorithm to solve some of the underlying optimization problems. An undergraduate research assistant will get research experience in computational fluid dynamics, optimization, and dimensionality reduction.



(a) HFM



(b) $k = 2$ ROM solutions for μ_{10}

Figure 1: Transonic flow around heaving NACA0012 airfoil (1a), comparison of high-fidelity model (thick grey) and their reduced order representation in Eulerian (dashed blue) and Lagrangian (solid red) framework (1b).

Student background and expected research activities: We are seeking an enthusiastic and highly motivated student who is interested in computational engineering, fluid dynamics, high-speed flows, and optimization. Basic programming skills including MATLAB are preferred by not required.

Point of contact: Prof. Maciej Balajewicz, `mbalajew@illinois.edu`