Flow control for turbulent drag reduction and rheology

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This talk will start with introducing various fluid mechanics projects conducted in the Park research group at Nebraska, encompassing a wide range of Reynolds number flows. I will then focus on two projects at very different Reynolds numbers. For both projects, the modeling, analysis, and computation will be presented along with their engineering applications. The first part is dedicated to high Reynolds number flows (turbulent flow), where three flow-control methods are investigated to distinguish their underlying drag-reduction mechanisms. These methods include imposing an external body force, adding long-chain polymers, and utilizing slip surfaces. The second part is dedicated to low Reynolds number flows (Stokes flow), where dynamics and rheology of highly conductive particle suspensions in an electric field is investigated. In particular, I will present our intriguing findings at high concentrations, which could be useful for many applications, especially suspension-based flow batteries. Lastly, we examine active rheology control for shear-thinning or shear-thickening via the magnitude, direction, and frequency of the electric field.