

Design and Characterization of Pressure Monitoring and Insertion Systems for Intraparenchymal Convection Enhanced Delivery

Jakob Michiels¹

Flavia Vitale

¹ University of Pennsylvania

Neurological disorders pose a significant societal and economic burden. Common pharmacological therapies often can only manage symptoms and have limited efficacy. Intraparenchymal convection enhanced delivery (IP CED) is a neurosurgical technique for direct brain delivery of therapeutics. Currently, the main applications of IP CED are targeted chemotherapy for glioblastoma and gene therapy. While IP CED has advantages over systemic approaches, its benefits can be drastically reduced by inadequate coverage, excessive duration of the infusion procedure, and off-target effects. Addressing the limitations of IP CED requires thorough investigation and optimization of the relevant fluid dynamic and operational parameters. In this work, we present the design, fabrication, and characterization of low-cost, open-source, and fully automated CED cannula insertion control and pressure-monitoring systems. Using these automated CED control systems, we investigate the effects of pressure, insertion velocity, and flow rates on several outcome variables, including reflux, volume distribution, and infusion cloud morphology during CED in brain phantoms