# Jordan University of Science and Technology

## Computational Analysis of Enhanced Magnetic Bioseparation in Microfluidic Systems with Flow-Invasive Magnetic Elements

**Authors:** Saud Khashan, Anas Alazzam, Edward Furlani

**Abstract:** A microfluidic design is proposed for realizing greatly enhanced separation of magnetically-labeled bioparticles using integrated soft-magnetic elements. The elements are fixed and intersect the carrier fluid (flow-invasive) with their length transverse to the flow. They are magnetized using a bias field to produce a particle capture force. Multiple stair-step elements are used to provide efficient capture throughout the entire flow channel. This is in contrast to conventional systems wherein the elements are integrated into the walls of the channel, which restricts efficient capture to limited regions of the channel due to the short range nature of the magnetic force. This severely limits the channel size and hence throughput. Flow-invasive elements overcome this limitation and enable microfluidic bioseparation systems with superior scalability. This enhanced functionality is quantified for the first time using a computational model that accounts for the dominant mechanisms of particle transport including fully-coupled particle-fluid momentum transfer.