

# Masters Defense

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## *Continuous Hydrodynamic Separation of Particles in a Pinched Microchannel*

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### **Abstract**

Fast and high resolution analysis of biological cells and micro and nanoparticles is of prime interest for the development of medical point-of-care technologies as well as pharmaceutical and environmental research. There has been explosive growth in the development of miniaturized micro chemical systems based on the so-called “Lab-on-a-chip” concept. Most existing particle separation methods require application of external fields for separation which increase the device complexity and can limit their applicability. This thesis describes a separation method that makes use of laminar flow inside a microchannel for separation. The device consists of a microchannel that abruptly varies from a narrow channel to a wide one. Particles are pinched against one of the sidewalls in the narrow section at a distance equal to the particle radius. When the particles enter the expanded section they are separated in the transverse direction. The particles roughly travel along average streamlines that are linearly amplified from the narrow section into the broadened section resulting in transverse separation based on size. The devices are fabricated using conventional soft lithography of polydimethylsiloxane replica molding techniques. The particle trajectory and dispersion are studied using fluorescent microspheres and epifluorescence microscopy. The results show that separation resolution is a function of the microchannel aspect ratio, particle size difference, and various properties that control the dispersion of the particle distributions. This work allows a prediction of the separation resolution and highlights the importance of the device sidewall roughness on the dispersion and separation resolution. Separation resolutions as large as 5.2 are obtained in this work. These devices can be used to separate particles as small as  $2\mu\text{m}$ .