

**Dissertation press release** **14.05.2020**

## **Dances with waves: moving small objects with sound**

**Title of the dissertation** Controlling the motion of particles on a vibrating plate using dynamic acoustic fields

**Contents of the dissertation** Moving objects without touching them has been perceived as a sign of superhuman power in the history of humankind, with numerous fictional examples in ancient myths as well as in the contemporary cinema. In the recent decades, scientists have surpassed the crowd by putting considerable efforts to the realization of those fictional ideas. In particular, scientists in the area of miniature robotics have developed myriad of techniques for moving small objects in a contactless and precise manner. The development of those small-scale techniques are essential, due to the nature of the dominant forces at micro- and nanometer scale, which necessitates contactless methods of manipulation. Among the aforementioned techniques, acoustic manipulation, a technique that moves objects by sound, has emerged in the last two decades with a wide range of applications in biomedical research, microsystem assembly, and lab-on-a-chip. This doctoral dissertation introduces several breakthroughs related to acoustic manipulation techniques. First, it proposes a technique for controlling the motion of multiple small objects simultaneously and independently on a vibrating plate with a single acoustic source. Additionally, the dissertation extends the technique to the fluidic environments, and also proposes several open-loop, closed-loop, model-free, and real-time control techniques to facilitate more precise and faster motion control. The proposed methods allow the manipulation of a wide range of miniature objects including electronic components, water droplets, plant seeds and metal parts. Several applications are foreseen from this dissertation including shaping parts from particles, conveying microelectronic chips, delivering drug-loaded particles for pharmaceutical applications or handling small liquid volumes for lab on chips.

**Field of the dissertation** Automation, systems, and control Engineering

**Doctoral candidate** Kourosh Latifi, M.Sc.

**Time of the defence** 10.06.2020 at 14:00

**Place of the defence** Aalto University, School of Electrical Engineering, via remote connection

**Opponent** Professor Peer Fischer, Max Planck Institute for Intelligent Systems, University of Stuttgart, Germany  
Professor Michaël Gauthier, FEMTO-ST Institute, University of Bourgogne Franche-Comté, France

**Custos** Professor Quan Zhou, Aalto University, School of Electrical Engineering, Department of Electrical Engineering and Automation

**Electronic dissertation** <http://urn.fi/URN:ISBN>  
(permanent link to dissertation, if dissertation is already available in electronic form)

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