**TITLE**: Ultrasound-based Tracking and Closed-Loop Control of Soft Self-Folding Hydrogel Grippers

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**INTRODUCTION**: Minimally invasive surgical interventions could be drastically improved by substituting electrically wired instruments with smaller, maneuverable, untethered and reconfigurable devices. Here we discuss the ultrasound tracking of soft miniaturized grippers that are used using closed-loop control. The patterned bilayer structure of such millimeter grippers endows them with thermos-responsive and magnetic properties which can be exploited to perform complex tasks. The presented results, obtained with non-invasive ultrasound imaging, are promising for future applications in minimally invasive surgery [1].

**EXPERIMENTAL**: Grippers with biocompatible self-folding structure [2] are patterned with magnetic nanoparticles to allow their motion control with wireless magnetic fields. The used nanoparticles also act as contrast agent for ultrasound imaging. Noise reduction, feature extraction and clustering techniques allow to track the agent in the workspace using a B-mode ultrasound image. An electromagnetic experimental setup and a Peltier element allow to control the position and configuration of the grippers in the workspace.

**RESULT AND DISCUSSION**: Robust and efficient ultrasound tracking and motion control techniques are developed. These algorithms are used to demonstrate closed-loop motion control of soft grippers with ultrasound tracking. Differently from traditional imaging, this technique could be used in minimally invasive *in-vivo* experiments.

**CONCLUSIONS**: The study presents the fabrication, ultrasound tracking and motion control of biocompatible bilayer grippers. The design of the grippers takes into account their need to move using magnetic fields and allow their tracking with ultrasound imaging, without the need for optical feedback.

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**ACKNOWLEDGEMENTS**: This project (ROBOTAR) has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 Research and Innovation programme (Grant Agreement #638428). This work was also supported by funds from the Netherlands Organization for Scientific Research (NWO) Innovative Medical Devices Initiative (IMDI) - Project: USE (Ultrasound Enhancement). The research reported in this publication was also supported by the National Institute of Biomedical Imaging and Bioengineering of the National Institutes of Health (NIH) under Award Number R01EB017742. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.