

Title: Wireless and passive pressure detection using magneto-mechanical resonances in process engineering

Keywords: pressure sensor, magneto-mechanical resonator, sensing, resonance frequency, magnet-to-magnet distance

Authors:

Timo Merbach – 0000-0002-7723-5444

Institute of Multiphase Flows, Hamburg University of Technology, Hamburg, Germany

Felix Kexel – 0000-0003-4268-2348

Institute of Multiphase Flows, Hamburg University of Technology, Hamburg, Germany

Jonas Faltinath – 0009-0003-4128-2948

Institute of Biomedical Imaging, Hamburg University of Technology, Hamburg, Germany

Section of Biomedical Imaging, Medical Center Hamburg-Eppendorf, Hamburg, Germany

Martin Möddel – 0000-0002-4737-7863

Institute of Biomedical Imaging, Hamburg University of Technology, Hamburg, Germany

Section of Biomedical Imaging, Medical Center Hamburg-Eppendorf, Hamburg, Germany

Michael Schlüter – 0000-0001-5969-2150

Institute of Multiphase Flows, Hamburg University of Technology, Hamburg, Germany

Tobias Knopp – 0000-0002-1589-8517

Institute of Biomedical Imaging, Hamburg University of Technology, Hamburg, Germany

Section of Biomedical Imaging, Medical Center Hamburg-Eppendorf, Hamburg, Germany

Fraunhofer Research Institution for Individualized and Cell-based Medical Engineering

IMTE, Lübeck, Germany

Fabian Mohn – 0000-0002-9151-9929

Institute of Biomedical Imaging, Hamburg University of Technology, Hamburg, Germany

Section of Biomedical Imaging, Medical Center Hamburg-Eppendorf, Hamburg, Germany

DOI of publication: [10.1088/1361-6501/adf2c8](https://doi.org/10.1088/1361-6501/adf2c8)

DOI of data supplement: [10.15480/882.14543](https://doi.org/10.15480/882.14543)

License: CC0 1.0

Abstract of the paper:

A custom-developed magneto-mechanical resonator (MMR) for wireless pressure measurement is investigated for potential applications in process engineering. The MMR sensor utilises changes in the resonance frequency caused by pressure on a flexible 3D printed membrane. The thickness of the printed membrane plays a crucial role in determining the performance and sensitivity of MMRs, and can be tailored to meet the requirements of specific applications. The study includes static and dynamic measurements to determine the pressure sensitivity and temporal resolution of the sensor. The results show a minimum sensitivity of $0.06 \text{ Hz mbar}^{-1}$ and are in agreement with theoretical calculations and measurements. The maximum sensor readout frequency is 2 Hz in this study. Additionally, the temperature dependence of the sensor is investigated, revealing a significant dependence of the resonance frequency on temperature. The developed MMR offers a promising and versatile method for precise pressure measurements in process engineering environments.