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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Alstrøm, T. S., Bosco, F., Larsen, J., Bache, M., Brøgger, A. L., Frøhling, K. B., ... Boisen, A. (2014). Characterization of the time-evolving bending profile of micro-cantilevers. Poster session presented at 11th International Workshop on Nanomechanical Sensing, Madrid, Spain.

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CHARACTERIZATION OF THE TIME-EVOLVING BENDING PROFILE OF MICRO-CANTILEVERS

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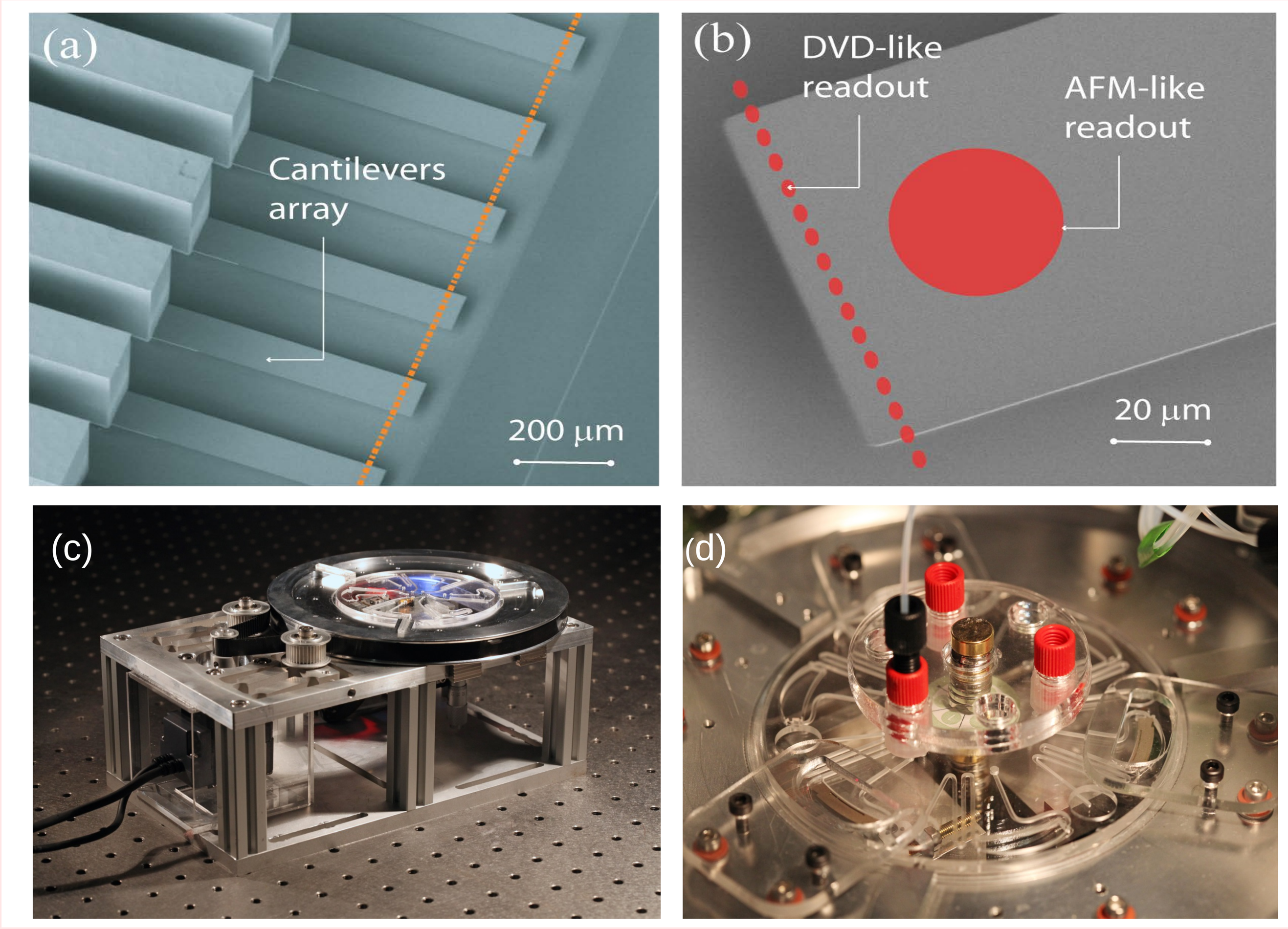
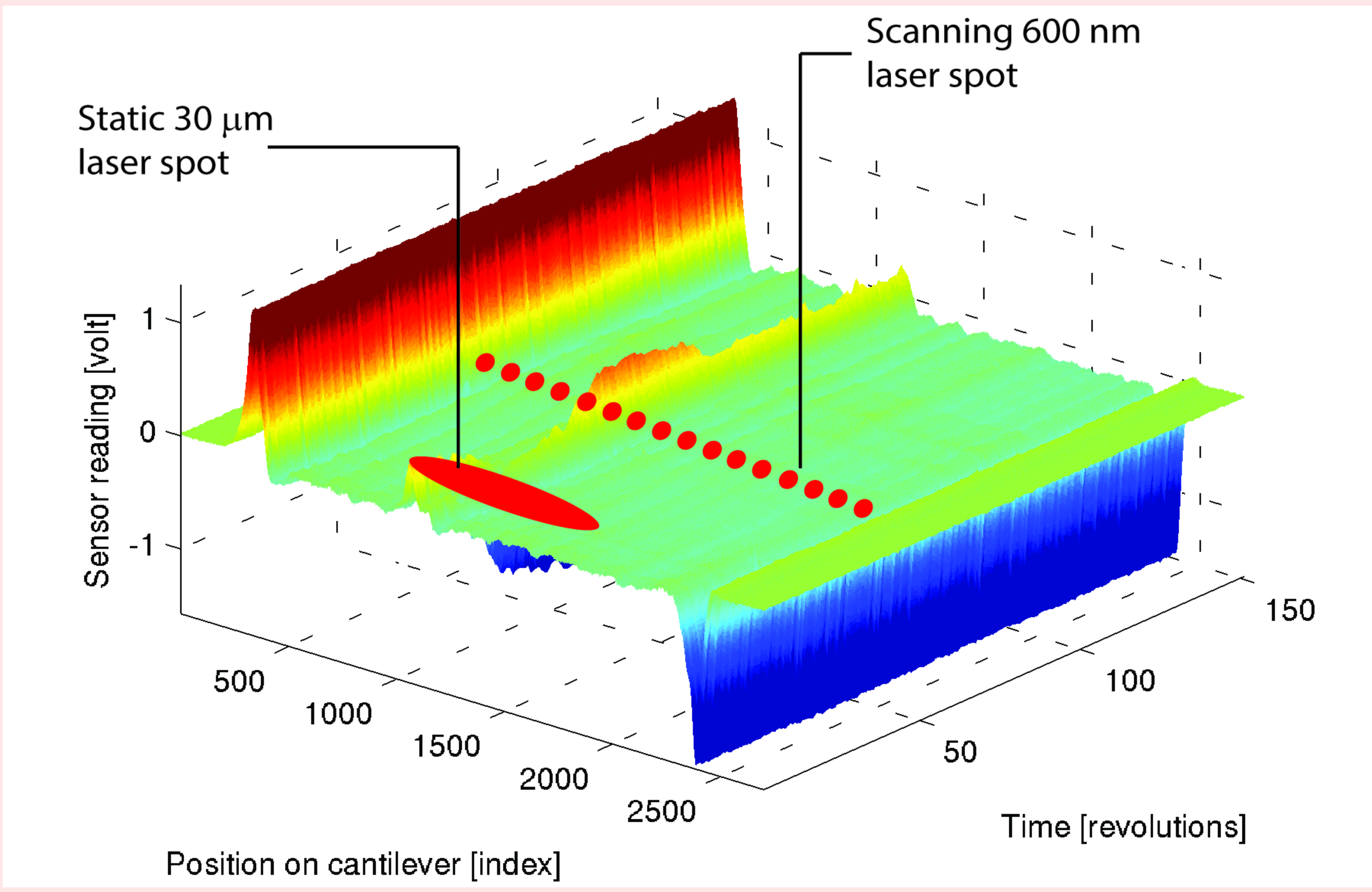
Introduction

- We present the **statistical analysis** of IBM style 8 cantilever sensors that are chemically functionalized for sensing specific biomolecules using a DVD-ROM optical drive [1].
- Several micromechanical-based sensing tools have been verified by their detection capabilities [2].
- In this work, we present **new insight on the behavior of cantilevers** made possible using a fully automated system for parallel microcantilever-based biosensing and **statistical analysis of data** [3].
- We are detecting an inflammatory biomarker, Soluble Urokinase Plasminogen Activator Receptor (**suPAR**).



a) The cantilever arrays used for the measurements. The orange dotted line is the scanning location. b) Our system compared to a traditional AMF-like readout. c) The DVD system. d) Close up of fluidic disc assembly



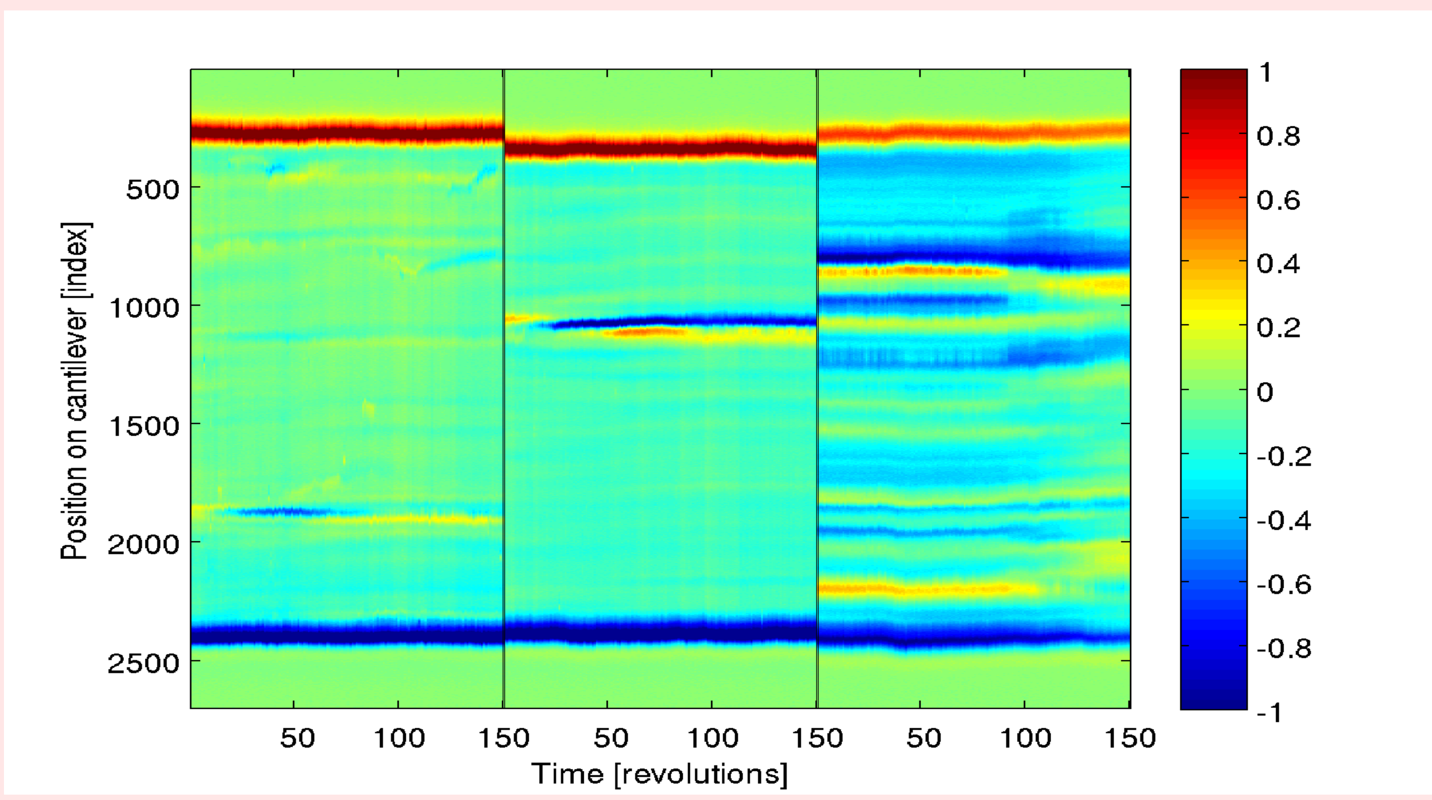
A cantilever visualized on a 3 dimensional plot with an anomaly that causes signal instability.

Cantilever surface analysis

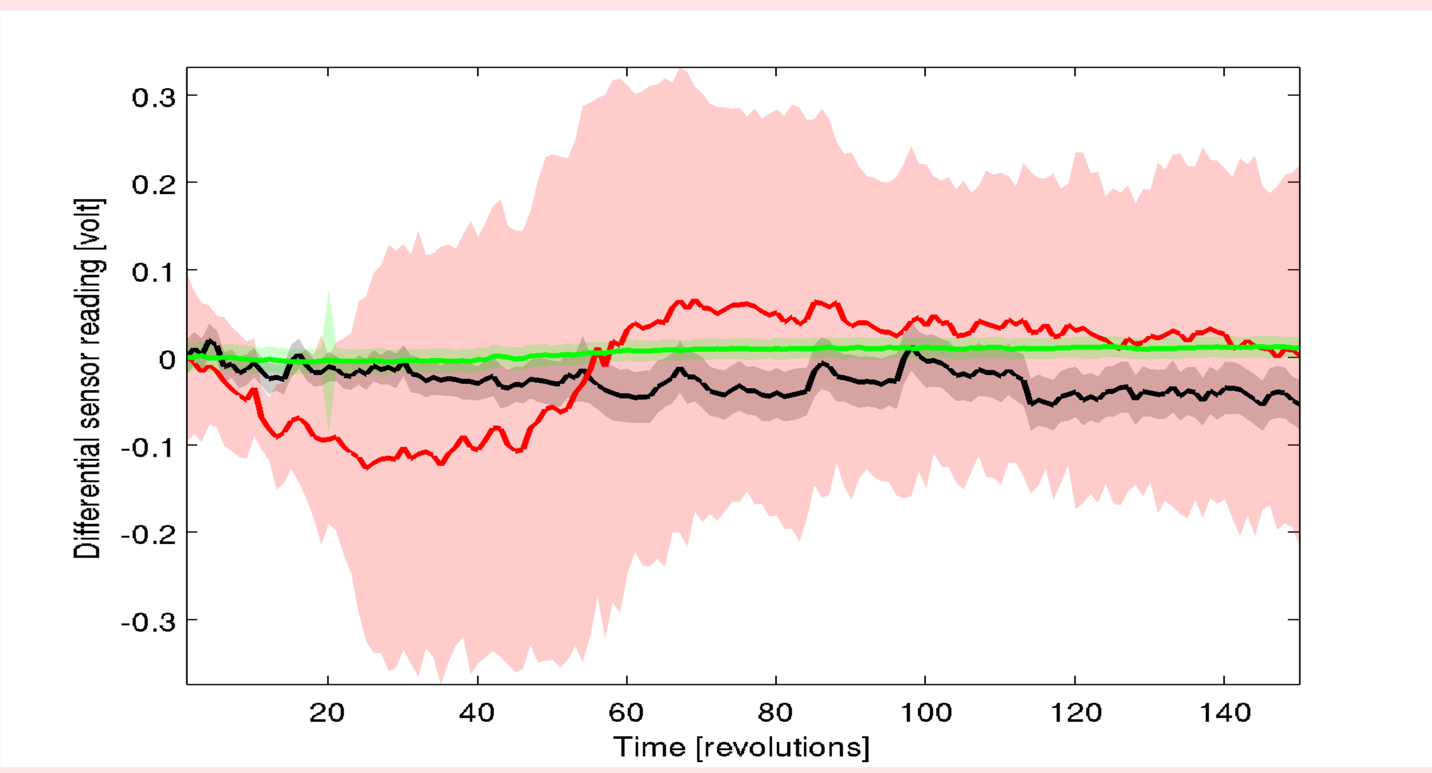
- The AFM approach uses an optical leverage system with a spot size of roughly 30 µm, the DVD pick-up has a spot size of ~0.6 µm and scans ~2000 locations across each cantilever apex.
- Each **suPAR** experiment collects ~**2 GB** data, and using a **MATLAB program** anomalies are located and the response is calculated using clean areas only.
- The **standard deviation** of the points **near the anomaly** is more than **one order of magnitude larger** compared to the smooth areas.
- The collected data allows a **more precise readout profile** and provides a **qualitative assessment** of the sensor surface.

Signal integrity verification

- The static response over time can be visualized and the quality of the cantilever surface assessed.
- The surface of cantilevers can be rather **inhomogeneous** and it **varies from cantilever to cantilever**.
- However, cantilever responses are “quite” stable over time, and this allows both for reliable **data integrity verification**, as well as estimating static response in case of missing cantilever readouts.



Three different cantilevers with different amount of roughness. The color encodes the static response. Each cantilever is measured on roughly 2000 locations for 150 revolutions.



Bending profile of a cantilever based on mean of 200 points. The red line is the mean response with the anomaly included, black line without anomaly. The green line is a reference. The shaded areas depict standard deviation.

Conclusions

- It is a **great advantage** to collect a multitude of data points, as this enables more **robust data processing**.
- The approach can be used to automatically verify **integrity of data**.
- The approach **prevents** that the presence of anomalies or data loss leads to **misleading conclusions**.
- We believe that it is **paramount** that cantilevers are **scanned in multiple areas** in order to ensure sensor reliability.

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MUSE Multi sensor DVD platform