SPECIMeN Team

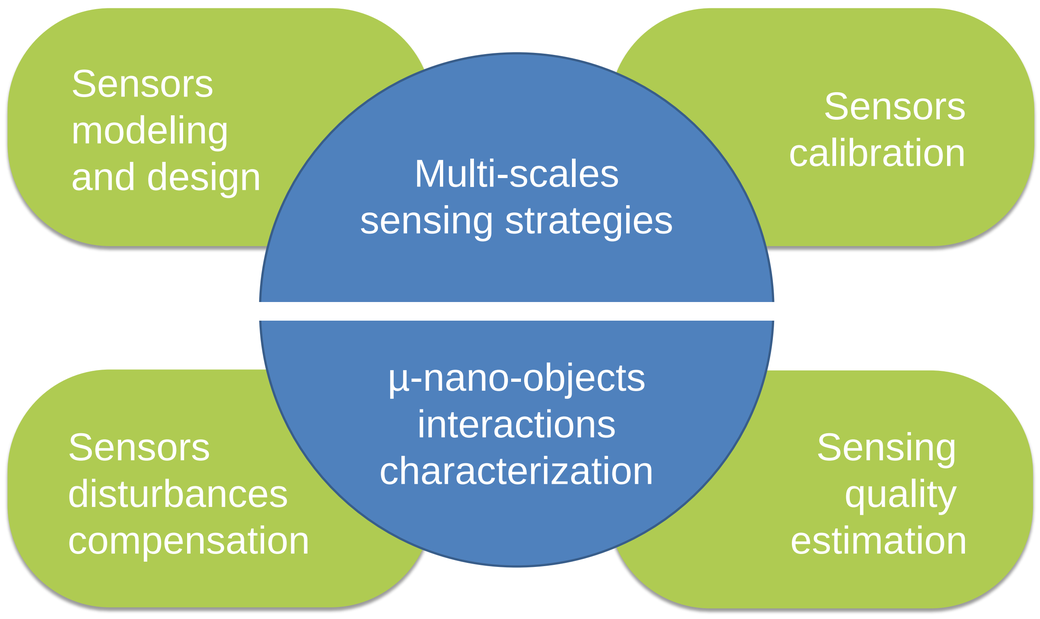
Sensing, Perception & Characterization at µ-nanoscales

Scientific objective

Mechatronic systems operating at micro- and nanoscales are based on innovative designs that require specific sensing devices and/or signal processing methods in order to optimize the overall performance of sensorimotor loops (sensing, control, actuation) operating at such scales in the global paradigm of µ-nanorobotics.

Scientist issues explored are mainly focused on:
- Design of sensors operating at µ-nanoscales,
- Multi-scales sensing strategies and interactions characterization.

Typically used / designed sensors: SEM, AFM, confocal chromatic, µ-nanoforce sensors based on magnetic springs and piezoresistive gauges, …



General presentation

Permanent staff: 1 professor, 2 associate professors and 3 research engineers.

Non-permanent staff (2014): 1 foreign invited researcher, 2 post-doctoral research fellows, 2 doctoral research fellows, 3 students internships positions.

Industrial and societal challenges

This team is involved in the development of several smart systems operating at µ-nanoscales (Labex ACTION):

- smart medical devices for single cell multi-modal characterization,
- Multi-DOF plateforms for multi-asperity nanotribological characterization,
- industrial integrated and low-cost microdisplacement sensors for microgrippers,
- 2D and 3D nanovision and nanocharacterization tools using a high resolution SEM platform (equipex robotex).

International relationships

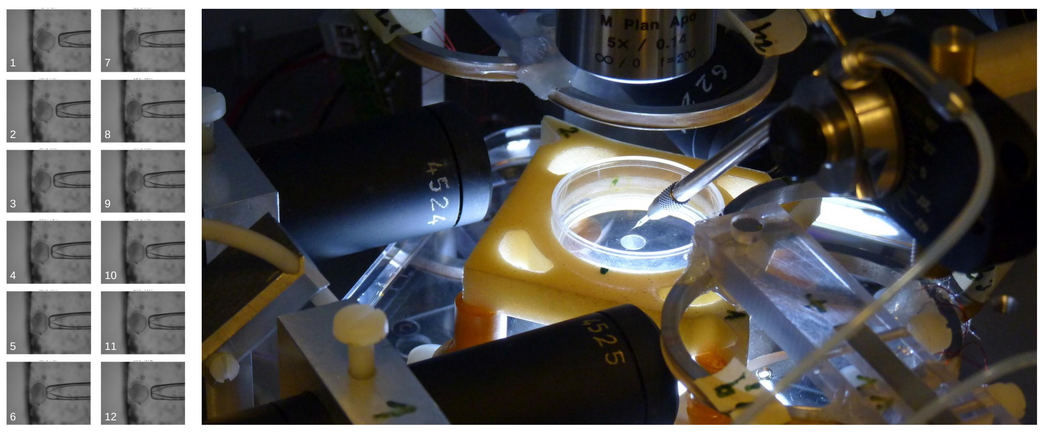
- Prof. Sergej Fatikov, Universität Oldenburg, 3D automatic handling and visual servoings.
- Prof. Martin Hoffmann, Technische Universität Ilmenau, discussion in progress around SEM imaging and nanocharacterization of materials.

Nanoforce sensors development for mechanical characterization

Objectives: development of force / torque sensing platforms using passive magnetic springs and piezoresistive gauges.

Positioning: mono or multi-DOF with low coupling, rigid or elastic transducers, negligible inertia or not, high resolution / measurement range, sensor dynamic deconvolution with SNR / bandwidth adjustment.

Highlight: human oocytes mechanical characterization using a 2-DOF nanoforce platform based on floating magnetic springs.



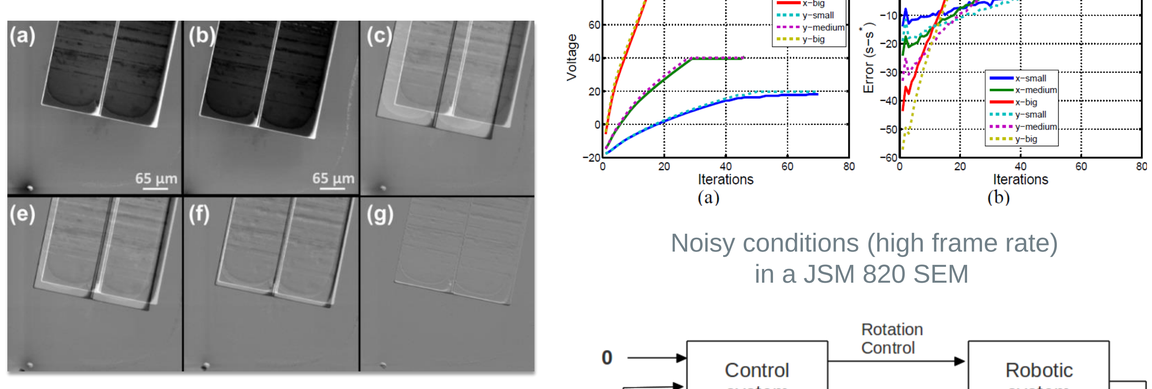
Perspectives and current stakes: mechanical disturbances compensation, sub-nanoforces measurement, traceable µ-nanoforces.

Nanovision for nanorobotics based on scanning electron microscopy

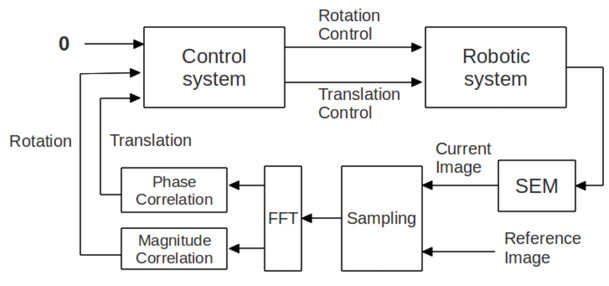
Objectives: development of robust visual servoing methods in SEM using global visual features for auto-adaptive imaging in nanorobotics tasks.

Positioning: visual servoing schemes for nanopositioning tasks in SEM, fast and efficient autofocusing in SEM, depth estimation in SEM using visual servoing and sharpness function.

Highlight: Fourier based visual servoing with sub-pixel accuracy for nanopositioning in SEM.



Noisy conditions (high frame rate) in a JSM 820 SEM



Perspectives and current stakes: High resolution 3D reconstruction in SEM using visual servoing and structure from motion.

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