

# Signals Measurement and Estimation Techniques Issues in the Micro/Nano-World

[www.femto-st.fr/WS-icra10/](http://www.femto-st.fr/WS-icra10/)

Cédric Clévy

Micky Rakotondre

Nicolas Chaillet

FEMTO ST  
INSTITUT DE RECHERCHE

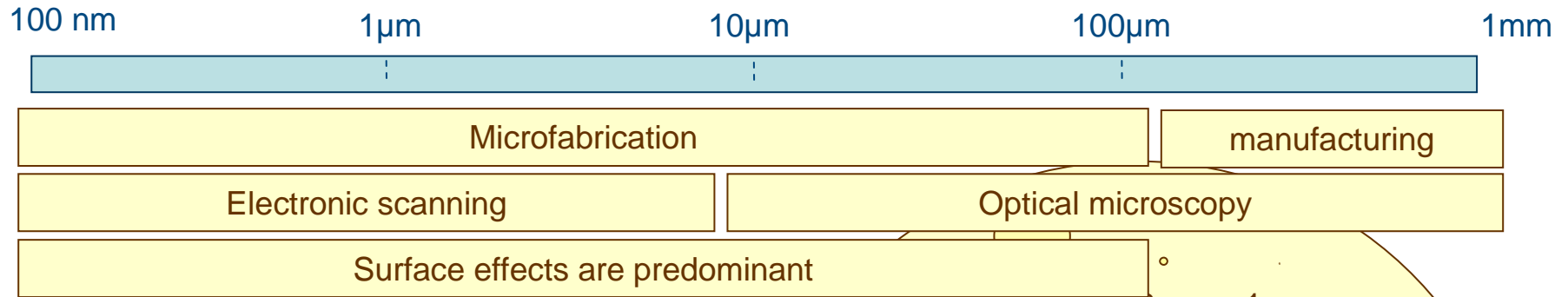


cultiver  
l'innovation,  
de la recherche  
fondamentale  
au partenariat  
industriel

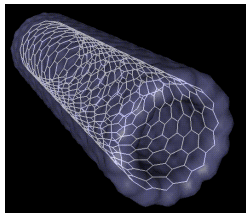


microPAdS

[www.femto-st.fr](http://www.femto-st.fr)

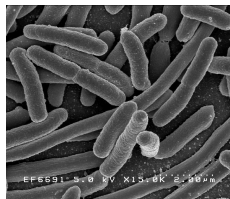


carbon nanotube



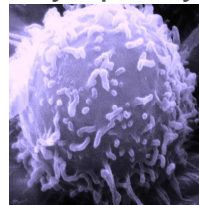
Diameter: 100 nm

bacterium



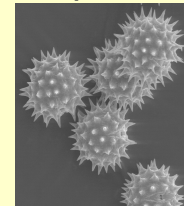
2-6 μm

lymphocyte



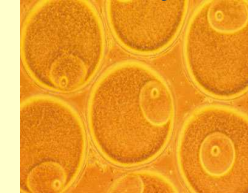
6-15 μm

pollen



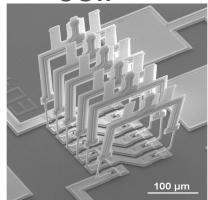
20-40 μm

oocyte



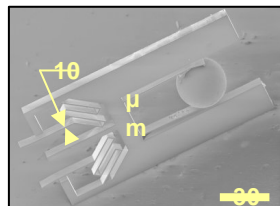
200 μm

coil



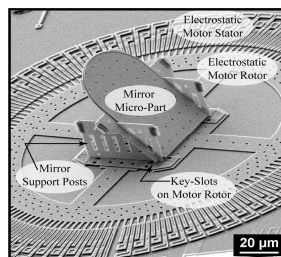
130 μm

Lens with its support

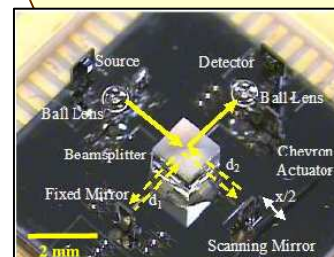


500 μm

mirror



spectrometer

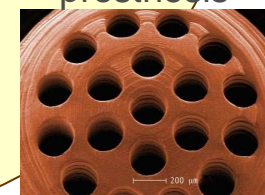


Gear wheel



800 μm

Hearing prosthesis



1 mm

Assembled systems

- **Consequences of scaling down:**
  - needs of microsystems or systems acting at the microscale
  - requirements of measurements (Force & position) for control issues or to understand physical phenomena
- **Micro-nano scale specificities:**
  - Signal of very small amplitude, small signal to noise ratio
  - Influence of surface forces
  - Small free space
  - Resolution in the submicron and micro-Newton range
  - Influence of environment

- **Existing sensors**

- Interferometers
- Scanning electron microscopes
- Cameras
- Laser sensors
- Strain gage
- Piezoceramic sensors
- Capacitive sensors
- ...



+	-
---	---

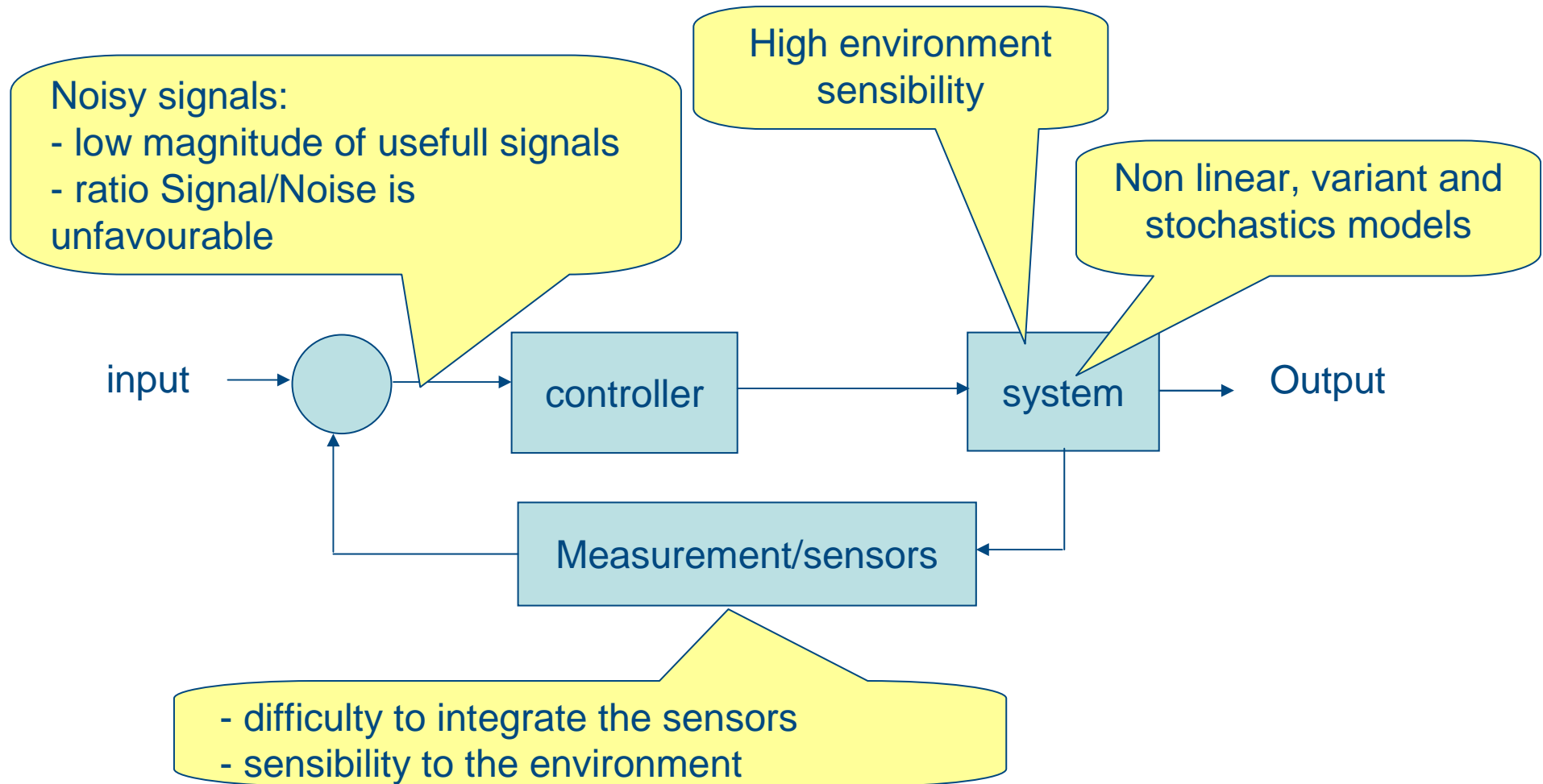
<b>Range, resolution, bandwith, robutsness</b>	<b>Size, Nbe DOF, price</b>
--	-------------------------------------

<b>Size, range, resolution</b>	<b>Robustness fragility</b>
--	---------------------------------

Lack of sensors with suitable range, accuracy, bandwith, number of DOF and size

➡ Pushing back of the limits of automation

➡ Development of new sensors



- 9:00 am** Observer techniques applied to the control of piezoelectric microactuators  
*Micky Rakotondrabe, Cédric Clévy, Ioan Alexandru Ivan and Nicolas Chaillet, from FEMTO-ST (Besançon, France)*
- 10:00 am** Measurement and control for high-speed sub-atomic positioning in scanning probe microscopes  
*Andrew J. Fleming and Kam K. Leang, from University of Newcastle (Callaghan, Australia) and University of Nevada (Reno, USA)*
- 11:00 am** Microrobotic tools for the measurement of small forces  
*S. Muntwyler, F. Beyeler and B. J. Nelson, from ETH (Zurich, Switzerland)*
- 1:30 pm** In-situ mechanical characterization of mouse oocytes using a cell holding device  
*Roxanne Fernandes, Andrea Juriscova, Robert F. Casper and Yu Sun, from University of Toronto (Toronto, Canada) and Samuel Lunenfeld Research Institute, Toronto Mount Sinai Hospital (Toronto, Canada)*
- 2:30 pm** In situ characterization of thin-film nanostructures with large-range direct force sensing  
*Gilgueng Hwang and Stéphane Regnier, from University Pierre et Marie Curie (Paris, France)*
- 3:30 pm** A mechanism approach for enhancing the dynamic range and linearity of MEMS optical force sensing  
*Gloria J. Wiens, from University of Florida (Gainesville, USA)*
- 4:30 pm** Observer-based estimation of weak forces in a nanosystem measurement device  
*Alina Volda, from GIPSA-Lab (Grenoble, France)*