Open PhD Position: Study and development of a multimodal micromechanical / optical device for the maturity characterization of human oocytes.

Laboratory – city – country
FEMTO-ST Institute – Besançon – France
http://www.femto-st.fr/en/

Femto-st Institute is a joint laboratory affiliated with the french National Scientific Research Center (CNRS), the University of Franche-Comté (UFC), the National School of Mechanical Engineering and Microtechnology (ENSMM), and the Belfort-Montbéliard University of Technology (UTBM). Today FEMTO-ST includes around 700 members with about 325 permanent positions. About 225 doctorate students receive a high-level training in scientific research. In 2012, it was rated A+ (the highest rate) by the French Research Evaluation Agency (AERES).

Supervision
Emmanuel Piat, Associate Professor (femto-st / AS2M department) – PhD supervisor.
Bruno Wacogne, CNRS Research Director (femto-st / Optics department) – PhD supervisor.
Christian Pieralli, CNRS Senior Researcher (femto-st / Optics department) – co-supervisor.
Joël Abadie, CNRS Research Engineer (femto-st / AS2M department) – co-supervisor.

Context
A full funded PhD studentship is available as a part of the French regional project MICROBE: “from tissues to microparticles: multi-scales characterization and qualification of biological systems”. The studentship will start between October 1st, 2013 and January 1st, 2014. This studentship is funded for 3 years. The student will be based in two departments of the FEMTO-ST Institute:

- AS2M Department / SPECIMeN group
http://www.femto-st.fr/en/Research-departments/AS2M/Research-groups/SPECIMEN/

- Optics Department / Biophotonic group
http://www.femto-st.fr/en/Research-departments/OPTICS/Research-groups/Biophotonics/

The MICROBE project also includes a partnership with the AS2M / PHM group (Prognostics and Health Management), the FEMTO-ST Applied Mechanics department and the Medically Assisted Procreation Unit of Besançon University Hospital.

Requirements and contact
The PhD candidate will have a strong interest in micromechatronics and microsystems for optics and mechanical characterization; strong mathematical skills associated with mechanics, control theory and signal processing; normal programming skills (Matlab, C / C++); good written and spoken communication skills in French or English. The ideal candidate will be able to conduct theoretical researches, but also implement them in real devices.

Applicants should send (preferably as a single PDF file):

- a CV,
- a brief statement of research interests,
- references (with email and phone number),
- their academic transcript (with rank if possible).

This information has to be send to:
Emmanuel piat – emmanuel.piat@ens2m.fr
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Short project description

Current assisted reproductive technology (ART) only provides subjective visual means of assessing the maturity of human oocytes [1,2]. This characterization and the diagnosis of mature oocytes is particularly difficult to perform because of the complex and variable dynamical evolution of each components constituting the human oocyte (nuclear material, cytoplasm and zona pellucida) [3,4]. Thus, a new technology, compatible with physician's protocols and constraints, is required [5] in order to provide analysis methods, preferably on a multimodal basis, to improve the diagnosis reliability [9].

Research works on human oocytes characterization are still marginal, partially because bio-ethics constraints make the research on non human oocytes easier to perform [6,7]. Regardless the type of oocyte, devices enabling a multimodal analysis of their maturity based on mechanical tests and optical characterizations are not available and should be studied and developed. The mechanical tests should enable the stiffness determination of oocytes for different load. First studies conducted at the AS2M department with a nanoforce sensor using magnetic springs [12-15] tends to prove that the minimal human oocyte stiffness is around 0.007 N/m and seems to raise during the oocyte maturity process. The Optics department also studied several optical characterization techniques based on the Karhunen-Loeve transform [10] and a spectral absorption analysis [11]. These non-contact methods are promising because they have no deleterious effect on oocytes. Both mechanical and optical approaches are thought effective to establish reliable diagnosis despite the variability of the oocytes evolution.

The goal of this PhD position is to develop a new modular micromechanical / optical device to perform sequential multimodal maturity analysis. All parts in contact with the oocyte must be low-cost, sterile and disposable. The device should be compatible with the framework used in the ICSI (Intra cytoplasmic Sperm Injection) processing and should also be coherent with physician's protocols. The Integration of a low cost and high sensitive nanoforce sensor inside the device with the previous constraints is notably a complex and interesting challenge. Design based on magnetic springs will be privileged.

References

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