

Co-Directors' Remark on LIMMS Special Issue

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1. What is LIMMS?

The Laboratory for Integrated Micro Mechatronic Systems (LIMMS) is an international joint research group on micro-mechatronics. Micromechatronics is one of the emerging research fields, which is usually referred to as micro/nano-electro-mechanical systems (MEMS or NEMS in short). In Europe it is also called MST or micro system technology. MEMS deals with very small integrated systems that include "mechanically functional" devices, and LIMMS versions of MEMS are such as micro tools for bio- and molecular engineering, small tools for new methodology, new devices for fiber optic network. We also cover new technology for micro/nano fabrication processes and integrated electronics in the nanometric scale. In this special issue of LIMMS, readers will find some of our recent research topics of MEMS and NEMS in the following articles.

2. History and structure

LIMMS was established in January 1995 in between IIS and the

SPI (Science pour l'Ingénieur), the department of Science for Engineering with France Centre National de la Recherche Scientifique (CNRS), and has been supervised by department of Information and Communication Sciences and Technologies (or STIC) since 2000. LIMMS started in the old IIS in Roppongi, and today it is located in the new Komaba-II campus of the University of Tokyo. LIMMS has so far welcomed more than fifty French scientists including post-doctoral students supported by the Japan Society for the Promotion of Science (JSPS) fellowship program and CNRS permanent researchers by their own funding for two years usually. Taking a snapshot of LIMMS members, one would see ten French researchers on average at a time, which means some ten research projects are developed at a time.

Figure 1 shows the structure of LIMMS researcher exchange program between the French counterparts. LIMMS and its members are physically located in the IIS but with some external cooperative professors of the University of Tokyo. There is another structural shell called CIRMM, Center for International Research on Micro Mechatronics, which is a hub structure for the

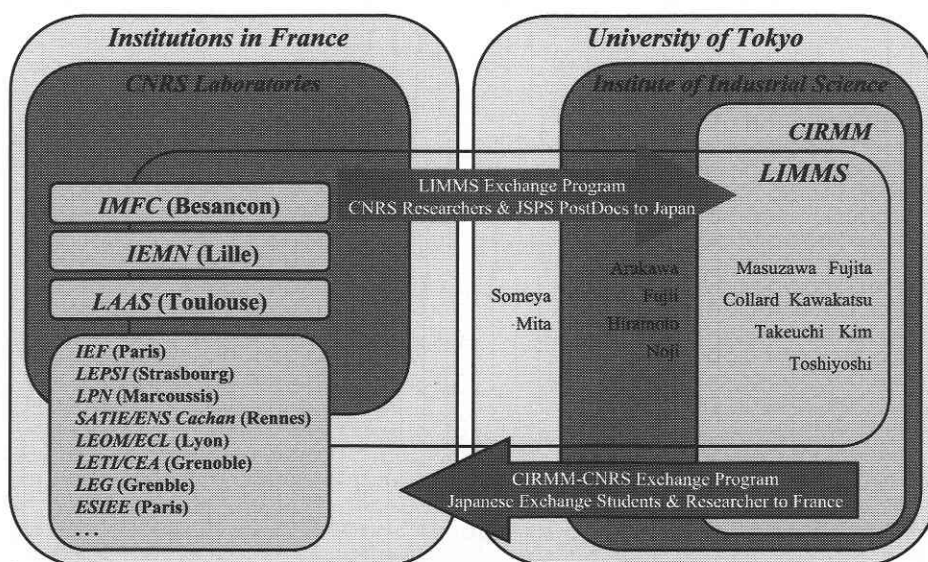


Figure 1. LIMMS/CNRS-IIS Structure with host professors

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international collaboration on MEMS/NEMS at IIS. CIRMM holds several international links to, for instance, Korea, Germany, Switzerland, Finland, and the Netherlands; and LIMMS is the most contributing part of CIRMM to France. On the French side, LIMMS was started by the three founding institutions of CNRS, namely IMFC (Institut des Microtechniques de Franche-Comte) in Besancon, IEMN (Institut d'Electronique de Microélectronique et de Nanotechnologie) in Lille, and LAAS (Laboratoire d'Analyse et d'Architecture des Systèmes) in Toulouse. Today we have more than ten partner institutions distributed in France.

3. Interface between different countries and disciplines

The purpose of our research activity at LIMMS is to combine expertise of both Japanese and French researchers and to explore new frontiers of MEMS and NEMS for various fields, namely, integrated micro/nano-mechatronics, micro robotics, nano metrology, micro/nano photonics, bio-engineering, molecular engineering, and integrated circuits by the aids of several host laboratories in the campus of IIS. Our research co-workers from France come mainly from the research institutes of CNRS. They are either post-doctoral fellows (of JSPS) or CNRS permanent researchers. They do not necessarily have to be working in MEMS or NEMS beforehand but they come with various backgrounds and enthusiasm for their new research career. Once they arrive in Japan to find a position in the framework of LIMMS, they will be working with Japanese partners of MEMS or NEMS, and

they start their own projects. Starting a new project in foreign country is really challenging for the visitors. Usually we arrange for them Japanese partners of the same or nearest research topics to support technical aspect of their projects such as MEMS processes. Japanese partners are sometimes faculty members of IIS (or in other campus), their experienced research staff and/or their students. LIMMS provides an interface between the Japanese and French researchers of MEMS and NEMS to extend their research interest in a cooperative manner with valuable guidance of their host professors.

The host faculty members and their research topics are listed in Table I; we are proud of being able to work with these world-leading advisors in the fields. Under their wide range of expertise, LIMMS researchers are working in different topics; and it makes it difficult to pick up one to represent all. If requested, however, we would present recent works on bio-MEMS that use in-vitro living molecules of muscle (in nanometer range) as a mechanical actuator for delivering force to something pretty much larger (still in a micron range, though). Table II shows year 2003 version of LIMMS French members and their research topics. Reader will notice again that our research projects are steered towards more in nanotechnology and biotechnology related topics.

4. Transition of LIMMS function

For the very first couple of years of LIMMS, it mainly worked to transfer the new technologies of MEMS from the research groups at IIS to CNRS institutions. At that time of MEMS devel-

Table I. Host professors in LIMMS and their expertise

Host Professor	Research Topic
Yasuhiko Arakawa	Quantum Nanostructure Devices
Dominique Collard	Applied (Information-Communication) Microsystems
Teruo Fujii	Integrated Microfluidic Systems
Hiroyuki Fujita	Micro / Nano Electro Mechanical Systems
Toshiro Hiramoto	Integrated Device Engineering
Hideki Kawakatsu	Advanced Scanning Probe Microscopes
Beomjoon Kim	Microcomponents and Systems (Self Assembly)
Takahisa Masuzawa	Micromachining and Measurement
Yoshio Mita	MEMS Integrated VLSI Systems
Hiroyuki Noji	Biomolecular Mechanics
Takao Someya	Organic Semiconductor Micro/Nano Devices
Shoji Takeuchi	Bio Microsystems
Hiroshi Toshiyoshi	Micro Opto Mechanical Systems

(alphabetical order)

Table II. Year 2003 version of French researchers in LIMMS and their research topics

CNRS Researchers	
Gonzalo Cabodevila	Microrobotics for bioengineering
Yves-Andre Chapuis	Distributed micro control systems
Philippe Coquet	Millimeter wave microsystem for biomedical applications
Jean-Bernard Pourciel	Micromethodology? Micrometrology? using MEMS tools
Vincent Senez	Microfluidic systems for bioengineering
JSPS Post-doctoral fellows	
Serge Camou	MEMS On-chip fluorescence spectrosopes
Nicolas Tiercelin	Magnetostrictive MEMS optical scanners
Guillaume Tresset	Microfluidic devices for electrofusion of biological membranes
Julien Brault	Nanoscale semiconductor devices
Yannick Rondelez	Biomolecular MEMS
Serge Ostrovidov	Microfluidic MEMS for bioengineering
Alexis Debray	Optical MEMS for automobile application
Laurent Jalabert	Micro methodology by MEMS tools
Eric Leclerc	Microfluidic channel devices
Vincent Agache	RF-MEMS devices

opment, both of us were aware of the enabling power of MEMS technology and seeking for its potential applications where it is practiced. We worked together in developing new MEMS fabrication processes and new principle of microactuators, for instance. French researchers, who were relatively new to MEMS, learned fundamental skills including utilities for MEMS and returned to their home institutions in France. Most of them continued their research career in MEMS, and had delivered valuable technical and administrative contribution to their country by being a missionary of MEMS. In the following years, we discovered a new phase of collaboration by hosting their younger generation post-doctoral co-workers and pursued our common research goals in the real collaborative manner. Research groups on MEMS in France were tied with Japanese partners in IIS to extend and expand new frontier of MEMS. One good example out of the LIMMS collaboration pulled out another case; and the number of researchers ever hosted in LIMMS counts up to fifty or more. Today, we are no more in the teacher-student relationship but are independent research partners respecting and learning each other. As a sign of fruitful collaboration of LIMMS, we present the fact that we have been continuously publishing nearly fifty peer-reviewed journal and conference papers every year since 1999.

5. LIMMS has come to a new phase

Having spent eight years, LIMMS has been almost established in administrative aspect such as protocols in calling for post-doctoral fellows and CNRS researchers, organizing annual scientific committee for evaluation, and renewing research contract between IIS and CNRS as well as technical accomplishments. LIMMS has been highly acknowledged in CNRS, and they help very much to promote scientific and administrative activities of LIMMS; in fact, CNRS has recently provided an official position of administrative management officer in LIMMS at IIS. We are often referred to as the most successful international collaboration between France and Japan. In fact, what we are targeting today is the most successful international collaboration of the world. Both Japanese and French sides are currently putting more effort and commitment to promote LIMMS to be more distinguishable.

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