

Seminar

Dept. of ECE, Energy Systems Group

and

Department of Mechanical & Industrial Engineering

TITLE: Research on piezoelectric actuators at the Laboratory of Electrical Engineering and Power Electronics, Polytechnic-Lille, France

SPEAKER: Professor Frederic Giraud

**DATE & TIME: Thursday, September 3, 2009
2:00 p.m. – 3:30 p.m.**

LOCATION: MC331, Mechanical Engineering Building

Abstract:

Piezoelectric actuators are promising solutions in our everyday environment. They can help to reduce the bulk size of servo mechanisms and thus tiny devices can be built around them. They can also be at the origin of a new actuation process. But because they use a different energy conversion process – where the stresses are created inside the matter – they need specific control algorithms.

At the Laboratory of Electrical Engineering and Power Electronics, this topic is studied in order to provide new control laws. Work is first dedicated to create a causal modeling of the actuators. This modeling is then inverted in order to deduce control laws. This research has found applications in the domain of precise position control of optronic devices, and also in the domain of the virtual reality and the force-feedback haptic devices.

The presentation will be divided into 3 parts. First, a description of the lab activities will be given. Then examples of piezoelectric actuators will be presented: their performances their designs, trends and so on. Finally, the causal modeling, and some control algorithms will be presented. At each step of the presentation, a comparison with Electromagnetic actuators (their modeling or their performances) will be given.

Biography of **Professor Frederic Giraud**:



Frédéric Giraud is Associate professor in Electrical Engineering at the University of Lille (France). (PhD 2002)

He focused his research activities on the modelling and control of Travelling Wave Ultrasonic Motors (TWUM). Those motors use a different energy conversion process than classical electromagnetic ones and thus need specific control laws. These ones are deduced by an inversion process from a causal modelling of the motor. Moreover, because they output large torque at low rotational speed, these motors are very interesting in avionic applications, for positioning for example because they can save space and weight of a speed reducer. He was involved in a project lead by *SAGEM defense and security* which aimed at using piezoelectric motors instead of electromagnetic ones for lens positioning. This project used commercial motors for which a performing position control was needed. In 2003 he became a team member of *INRIA's ALCOVE project* (Collaborative interactive virtual environment) which proposes interaction models that apply to 3D complex virtual objects and experiments them on two applicative themes: surgery simulation and collaborative virtual environments. Within the framework of this project, another part of his research activities is dedicated to *haptic devices*, and more precisely how to use TWUM in such applications. The goal is to find the best way to take benefit of their performances. But he also probes further new control methods specific to the motor.

Since 2004, he has been deeply involved in the *STIMTAC project of IRCICA* which aims at providing desktop device which can simulate touch sensation of any surface. He proposed then to use the *squeeze-film* air bearing for providing the tactile feeling, and contributed to the realization of a prototype.