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DEGLI STUDI  
DI BRESCIA



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Dottorato di Ricerca in  
**Ingegneria dell'Informazione**  
Corso di  
Elettronica per Strumentazione Sensori e Microsistemi

Lecture by

**Dr. Joshua Lee**  
*City University of Hong Kong*



## **Piezoelectric MEMS Resonators for Frequency Control and Sensing**

**Tuesday, June 26**  
**at 14:30, Room N10**  
Sede Ingegneria - Via Branze 38

**Abstract:** Piezoelectric bulk materials have had a long-established presence in the areas of frequency control (e.g. Quartz crystals, SAW and BAW) and sensing (e.g. QCM and strain sensing). But the last two decades has seen substantial progress in piezoelectric thin film deposition technology driven by developments in high-volume manufacturing. This is particularly the case for CMOS-compatible piezoelectric aluminium nitride (AlN) thin films. This seminar will first highlight some advances towards low impedance and high-quality factor (Q) resonators for frequency control, delivering Qs above 10,000 and impedances below 50 Ohms in the upper VHF range. These high-performance resonators have been used to realize low phase noise oscillators. The rest of the talk will illustrate how the advantages of AlN technology might be exploited to realize resonant sensors targeting operation in ambient conditions and dissipative media (as opposed to vacuum, such is commonly the case in state-of-art capacitive resonators). Three examples will be described. These include (1) resonant sensing platforms operable in liquids for biosensing applications, (2) MEMS magnetic sensors targeting electronic compass applications for next-generation integrated inertial measurement units without the constraint of requiring vacuum packaging, and (3) air-coupled micromachined ultrasonic transducers for touchless sensing applications.

**Biography:** Dr Joshua Lee received the B.A. (Hons) and M. Eng. (Distinction) degrees in 2005, and the Ph.D. degree in 2009, all from the University of Cambridge, U.K. He joined the faculty of the Department of Electronic Engineering, City University of Hong Kong in June 2009, where is currently an Associate Professor and is affiliated with the State Key Laboratory of Millimetre Waves. He is also the Program Leader for Graduate Research Degrees, in which capacity he is responsible for graduate affairs and admissions. In 2017, he was a visiting professor at University Grenoble Alpes in France. His research interests include the design, analysis, and characterization of Micro Electro Mechanical Systems (MEMS) for sensing and frequency control applications. Dr Lee is a Senior Member of the IEEE. He has served on the Technical Program Committees of various conferences including ISQED and IFCS.

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