Gas sensing using near-IR and mid-IR tunable semiconductor lasers for industrial and bio-sensing applications

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Abstract:
This talk will describe the research currently being undertaken in the Photonic Sensors Lab in IIT Gandhinagar. The lab uses near-infrared and mid-infrared tunable diode laser absorption spectroscopy (TDLAS) as the main sensing technique to measure gas concentration, pressure and temperature for industrial and biological applications. TDLS uses narrow linewidth semiconductor lasers for accurate recovery of the absolute rotational-vibrational absorption lines of gases. The rotational-vibrational absorption lines of gases have information about the concentration, pressure and temperature of the gas embedded in them. Our group uses calibration-free wavelength modulation spectroscopy (WMS) techniques to build compact TDLAS systems. These systems have low power requirements, are easy to reconfigure for multiple gases, and can be readily interfaced to electronics and communications systems. The portability of these systems makes field-deployable either in the form of fixed installations or mounted on unmanned land-based or airborne vehicles. Measurements can be done in real-time with fast embedded electronics. Our specific areas of focus are -

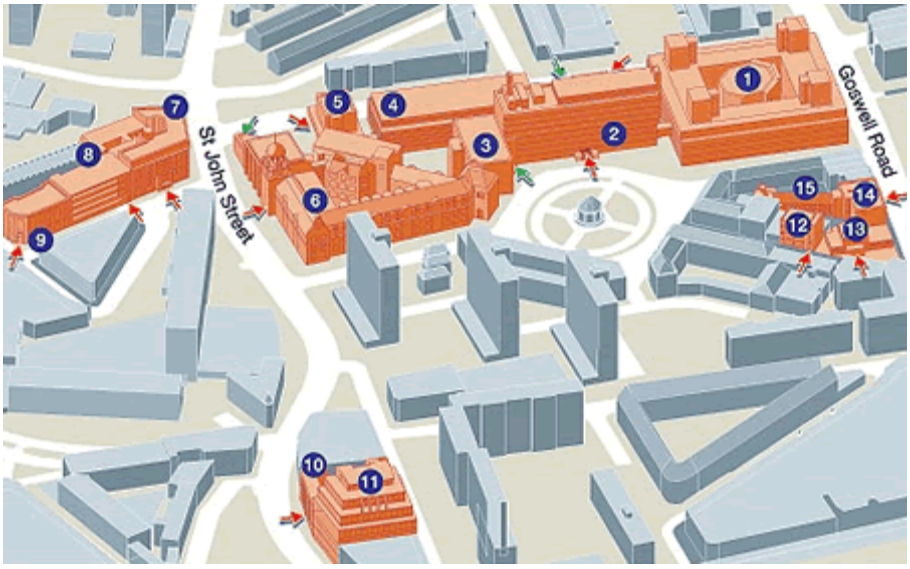
1) **Industrial hazard monitoring**: detection of hazardous gas leaks to preempt industrial accidents
2) **Environmental monitoring**: development of a mid-IR quantum cascade laser-based mobile platform to generate urban emission maps
3) **Microbiological growth**: VCSEL-based studies of bacterial growth by measuring the carbon dioxide emission from bacteria cultures
4) **Nano-biosensing**: development of a gold nanorod-based miniaturized multi-component biosensing platform
5) **Biomedical sensing**: using tunable lasers to interrogate fiber Bragg grating-based sensing glove to detect hand flexure with very high accuracy

Biosketch

Dr Arup Lal Chakraborty is a faculty member at the Indian Institute of Technology Gandhinagar (IITGN) in Gujarat, India since 2010. He is currently an Associate Professor in the Electrical Engineering discipline. He leads the Photonics Sensors Lab that has a diverse set of interests such as industrial process monitoring and safety, microbiological and nano-bio-sensing applications, environmental monitoring and biomedical sensing. These activities are heavily inter-disciplinary and rely mainly on near-infrared and mid-infrared tunable diode laser spectroscopy techniques.

Prior to joining IIT Gandhinagar he worked as a Research Assistant in the Department of Electronic and Electrical Engineering, University of Strathclyde, Glasgow during 2007-2010 and obtained his PhD in 2010. His work there involved devising wavelength modulation spectroscopy schemes to achieve calibration-free measurements of gas concentration and pressure for industrial applications. He worked on distributed optical fiber sensing as a Scientific Officer at the Raja Ramanna Centre for Advanced Technology (RRCAT), Department of Atomic Energy, Indore, India during the period 2001-2007. He holds a Bachelor of Technology degree in Electronics and Communications from the University of Kalyani, West Bengal, India. He is a member of the IEEE, the OSA and the OSI. He serves the research community as reviewer of journals of the OSA and IEEE and as member of the technical programme committee of photonics conferences. In addition to his research activities, he has also held several administrative positions in IITGN including Academic Coordinator of the EE discipline and Member of the Academic Senate of IITGN. He is a trained violinist and is passionate about football and swimming.

Location: City, University of London, C304, Tait Building shown as14, Northampton Square, EC1V 0HB
Use main entrance shown by red arrow near Building 2
Date and Time: Friday, 1st June, Lecture from 5 pm to 6 pm
Coffees: from 430 pm.
Contact: Prof. B. M. A. Rahman, City, University of London, Email: b.m.a.rahman@city.ac.uk, 020 7040 8123, mobile: 079 31 256 982
Nearest Tube station: Angel, Northern Line (Bank branch). Use Main Entrance shown by a red arrow for University Building (2) on Northampton Square



From Angel tube station, as you come out of the station turn left (Going South). After 100 m, cross the main road (City Road) and walk along the St John Street. After the junction with Spencer Street (Traffic light), turn left on the Spencer Street. Just before the next traffic light (with Goswell Road) enter City University (use way on your right, in between buildings 1 and 2) and Main Entrance is round the building on your right (shown by a red arrow for building 2).
Once entered, come up to level 1, then left turn to enter Tait building (building no. 1), use stair or lift to come two floor up to level 3. Lecture room is C304. Coffees will be available from 430 pm.