

Guest Editorial

## **Bubbles and ultrasound**

Michiel Postema

Department of Engineering, The University of Hull, Kingston upon Hull HU6,  
United Kingdom

E-mail address: [m.postema@hull.ac.uk](mailto:m.postema@hull.ac.uk)

Ultrasonic imaging is becoming the most popular medical imaging modality. Taking into account all hospital expenses, the costs of ultrasound and of X-ray examinations are roughly the same, whereas MRI and CT scans are approximately three times as expensive. A basic B-mode ultrasound scan typically shows contrast at regions of differing acoustic impedance. However, blood is a poor scatterer of ultrasound waves at clinical diagnostic frequencies, and thus techniques to enhance contrast have naturally emerged over the last few decades. The development of ultrasound contrast agents, microscopically small bubbles with resonance frequencies in the clinical diagnostic range, has extended the functionality of standard sonography to perfusion assessment and even to molecular imaging.

More recently, therapeutic compounds have been incorporated with the shells of ultrasound contrast agent microbubbles. Together with the discovery of sonoporation, the transient formation of pores in cells under influence of ultrasound and microbubbles, this has led to a boom in ultrasound-assisted delivery research. As a result, the prediction of encapsulated

bubble behaviour in ultrasound fields has become a hot topic. Aided by high-speed photography, bubble oscillation, motion and effects on nearby objects are studied at MHz-range frame rates. The more we understand about bubble dynamics, the more sophisticated our detection techniques become, and the more creative our applications. This is illustrated by the numerous fields quite diverse from medical imaging, where bubbles and ultrasound have proven useful, such as ultrasonic cleaning and algae eradication.

What unites these fields is the challenging task to quantify and predict which bubbly phenomenon occurs under which acoustic conditions, taking into account the bubble encapsulations and the properties of the transportation medium. The Institute of Acoustics (IOA) 2008 Spring Conference aimed to represent all branches of current acoustically-related research and to encourage interaction between non-IOA researchers working predominantly in acoustics and IOA members. It was held at The University of Reading on 10th–11th April 2008. A special session on bubbles and ultrasound was organised, chaired by Dr. Paul A. Campbell from The University of Dundee and myself. It brought together a new generation of bubble–ultrasonics scientists, with diverse backgrounds in physics, engineering, medicine and chemistry. The papers in this special issue of Applied Acoustics are an excerpt of the outstanding contributions presented at the “Bubbles and Ultrasound” special session of the IOA 2008 Spring Conference. They serve to highlight the enormous progress that has been made over recent years, and also offer a tantalising suggestion to the fascinating applications that lie ahead.