The Department of Biomedical Engineering at Linköpings universitet is a national centre for research and education in Biomedical Engineering. The research is motivated by the requirements in healthcare and takes place in close collaboration with the biomedical industry and hospital clinics.

The department, which was founded 1972, pursues research and graduate and undergraduate education in the area of biomedical engineering. Since 1996 the department hosts the National Competence Centre “Noninvasive Medical Measurements – NIMED”. The department at the Institute of Technology is located at Campus US. The local connection to the University Hospital has a big impact both on research and education.

Research and graduate education
The research activities are focused on areas such as: biomedical optics, ultrasound and bio-acoustics, modelling and simulation in physiology, neuro engineering, knowledge-based decision support systems, and signal and image processing. The research bears the imprint of the interdisciplinary environment at Linköpings universitet. Collaboration is taking place both on a national and international level in close collaboration with the biomedical engineering industry and hospital clinics. There are four research divisions: Biomedical Instrumentation, Biomedical Modelling and Simulation, Physiological Measurements and Medical Informatics.

Undergraduate education
The master’s programmes in Applied Physics and Electronics, Computer Science Technology, Engineering Biology, Information and Communication Technology offer biomedical engineering as a special profile. Individual courses are open for many other programmes and for distance education. The curriculum is one of the most comprehensive in Europe. Proximity to the University Hospital and the clinical environment enables realistic demonstrations, workshops and real life laboratory lessons.
Research in Biomedical Instrumentation

This division advances theoretical and experimental research that relates to biomedical engineering systems for diagnosis and therapy. Activities include modelling and simulation, signal processing, experimental in-vitro and in-vivo instrumentation for performance and evaluation in clinical settings. An area of particular interest is biomedical optics. Models for light-tissue interaction and heat transfer, laser Doppler flowmetry, spectroscopy, microscopy and photo physics are important technological corner stones in our laboratories. The main application areas are: skin engineering where methods to analyse and interpret skin data captured from tumours, skin reactions and ulcers are developed and renewed. In the neuro-engineering field the applications are directed towards stereotactic neurosurgery using a radiofrequency technique and brain tumour discrimination. Cardiovascular applications include methods for perfusion and oxygenation measurements on the beating heart.

Research in Biomedical Modelling and Simulation

The research at the division of biomedical modelling and simulation encompasses the vast area from traditional basic physiology to advanced clinical applications. At present, one focus is the biofluid mechanics of the heart and the greater vessels, another the mechanics of the myocardium. In biomedical modelling and simulation we are using tools from the fields of mathematics, mechanics and physics in order to analyse structure and function of complex biological systems. The advanced model development is based on high quality measurements. Currently, non-invasive measurement techniques are utilised combined with computer models for data assimilation. The rapid development in computers enables the development of individually based models for advanced diagnosis, intervention planning and follow-up. The research area is cross-disciplinary and at present we are participating in the development of the Center for Medical Image Science and Visualization (CMIV), a joint venture between the university and the University Hospital.

Research in Physiological Measurements

The research covers areas from physiological modelling to non-invasive measurements of various physiological parameters. In medical ultrasound, bio-optics, bio-acoustics our main application areas are in the cardiovascular area. In ultrasound development of ultrasound contrast, methods to measure blood perfusion in the heart muscle are performed. Simulation and in-vitro modelling are used. Bio-optical research is performed on photoplethysmography, the origin of this signal and how this signal can be related to blood flow. Furthermore, absorption spectroscopy is used to study the chemical content in fluids and is applied to optimising the dialysis process. A concept in the bio-acoustic research is the intelligent stethoscope where physiologically relevant information is extracted from the signal. Intelligent sensors in home and primary health care is one main area of application.

Research in Medical Informatics

The overall purpose of systems developed in the field of medical informatics is to extract and present clinically relevant information. Medical information appears in many different forms: parameters, value measurements, time courses, images, volumes, image and volume sequences. Methods to attain new types of information are continuously being developed and the detail and quality of recorded data is increasing rapidly. Huge amounts of potentially relevant information can be tied to one single patient. In addition it is necessary to be able to integrate and analyse information from a large number of patients and time instances. This development has led to a situation where we, in a manner of speaking, are at risk of drowning in the overwhelming flow of information. To be able to extract the relations that are pertinent in a given situation and to present them in a way that is simple to understand is rapidly becoming the main problem. Efficient solutions to this problem will be crucial components in future health care. To develop principles and methods for such solutions is the goal of the research in the field of medical informatics. In particular the research group focuses on the development of systems for medical decision support and medical image analysis.