Research

Scientifically, the institute focuses mainly on applied research and development in cooperation with clinical departments and regional manufacturers of medical and healthcare technology (ELLA-CS). Gradually, the institute has managed to build a measurement and development laboratory for this research, equipped not only with unique instruments, but also with measurement systems and products of its own design. These include the Instron system for measuring the stress characteristics of materials or prototype medical devices made from them, such as reinforcements, filters or orthodontic springs and arches, which is complemented by an air-tempered chamber with a Julabo thermostat for testing materials with shape memory; measurement systems of our own design for measuring the stress characteristics of stents; the Nikon imaging system for analysing the surface properties of materials or studying more complex structures using fluorescence. The measurement systems are fully automated and computer-controlled using in-house software or use the capabilities of the National Instruments modular system and LabVIEW programming environment. For modelling and simulation purposes, we use the mutually compatible software environments Comsol, Matlab and Simulink. In addition to a number of publications, our scientific work in this area has resulted in a total of 5 utility models accepted by the Industrial Property Office in 2009, 2010 and 2014.

In collaboration with the neurology clinic, we are involved in the development of a non-invasive pressure sensor using the volume changes of the eyeball induced by cardiac activity, which can be used to monitor the hemodynamic parameters of the vascular system in the head region.

Extensive measurements for ELLA-CS were performed in collaboration with the Institute of Metallic Materials and Corrosion Engineering at the University of Chemical Technology in Prague. These included measurements of the mechanical properties of shape memory wires subjected to thermal and chemical exposure in order to optimise their heat treatment technology for the production of vascular reinforcements.

We are also cooperating with the Department of Biophysics and Physical Chemistry, Faculty of Pharmacy, Charles University in the development and testing of special instrumentation for measuring mechanical properties of tissue samples and experimental verification of interactions of tissue reinforcements with real tissues at the site of their application.

We have also established cooperation at the international level within applied research, either directly or through cooperating partners. In the field of hyperthermia this was AMC Amsterdam, in the field of intelligent materials in dentistry the Dentistry school of University Goteborg, in the field of informatics the University Amsterdam etc.

Other research activities of the institute are also focused on medical informatics, where we concentrate mainly on the creation of mathematical and statistical algorithms for decision-making from biomedical data, modelling and simulation of properties and interactions of developed therapeutic products and substitutes with the organism and pharmacokinetics. IT specialists from our institute (MUDr. Mašín, MUDr. Nosek) also contributed significantly to the creation and management of the faculty publication and educational portal Mefanet. Mefanet is a communication platform that brings together all medical faculties of the Czech and Slovak Republic for the purpose of sharing and collaboration in the creation of electronic teaching materials and represents, among other things, one of the European projects in which the Institute of Medical Biophysics has participated in recent years. Other European projects we have worked on include LEKFYZ, aimed at deepening the professional cooperation and networking of the Institutes of Medical Biophysics at the medical faculties in the Czech Republic, or the IT Medik project, where, in addition to creating our own e-learning courses, we also provided IT support for course developers from other departments.

Last but not least, the statistical group of the Institute of Biophysics and OVT (Ing. Bukač, Mgr. Selke-Krulichová, RNDr. Čermáková, Mgr. Záhora) has long been cooperating with many departments of the faculty and the University Hospital in statistical processing of medical data.