Winter School in Medical Engineering 2018
Key Areas: Prosthetics, Materials and Medical Simulations

19 - 24 February 2018

University of Applied Sciences Upper Austria
School of Medical Engineering and Applied Social Sciences Linz/Austria

www.fh-ooe.at/campus-linz
Winter School in Medical Engineering 2018
Key Areas: Prosthetics, Materials and Medical Simulations

Thanks to significant advances in technology, prostheses are no longer bulky things mainly designed to replace the shape of an absent limb. Special material technologies such as lithography can reduce the weight of a prosthesis by more than 90%. Moreover, the implementation of particular sensor technologies significantly improves the accuracy and precision of any movement. Finally, embedding easily programmable microcontrollers allows a prosthesis and its wearer to realize a large variety of complex movement patterns. Nowadays, prostheses are high-tech devices which foster the independence and autonomy of their wearers, thereby significantly improving their quality of life.

However, before prostheses can be fitted and worn, a variety of simulations and tests have to be performed to ensure correct functioning.

The Department of Medical Engineering and International Office of the University of Applied Sciences Upper Austria in Linz are pleased to welcome you to our first Winter School offering you a 6-day programme of lectures, workshops, laboratory and cultural activities. We sincerely hope that you enjoy your stay with us as well as find some time to discover Linz – it is the third largest city in Austria and the capital of the Province of Upper Austria.

For further information and registration please visit: www.fh-ooe.at/winter-school-mt-2018

FH-Prof. DI Dr. Martin Zauner MSc
Head of Department of Medical Engineering

Mag. Iwona Hunstorfer
Head of International Office
University of Applied Sciences Upper Austria (FH Upper Austria)

The University of Applied Sciences Upper Austria is the largest university of applied sciences in Austria and is an integral part of the tertiary education system. The organisation is defined by the requirements of regional employment and research needs. Four locations in Upper Austria’s central area offer innovative and interdisciplinary academic degrees, each with a different focus.

>> School of Informatics, Communications and Media
    Hagenberg Campus

>> School of Medical Engineering and Applied Social Sciences
    Linz Campus

>> School of Management
    Steyr Campus

>> School of Engineering
    Wels Campus

You will find more information at:
www.fh-ooe.com
The focus in Linz is Medical Engineering and Applied Social Sciences. Our aim is to prepare students for the leadership positions of the future. Because our programmes are designed around a common theme, the synergy effects are obvious: more knowledge, and a multitude of partner organizations, such as the Austrian Red Cross, leading charities and numerous human services organizations and companies such as Otto Bock.

All degree programmes combine comprehensive training with practice. The School of Medical Engineering and Applied Social Sciences offers study programmes at undergraduate (bachelor’s) and graduate (master’s) level.

**Medical Engineering** combines medicine and medical device technology, and prepares students to bridge the gap as Medical Engineers.

The course of study for a degree in **Social Work** trains students to advise and counsel people in distress, and enables graduates to plan and organize the helping process.

**Human Services Management** focuses on the business skills graduates need to work in organizations in the social services field. The programme in **Public Management** combines business administration, accounting, controlling, business information systems, law, and public finance.
**Programme**

**Monday, 19 February 2018**

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<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>09:00</td>
<td>Introduction FH Upper Austria and Medical Engineering</td>
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<td>09:30</td>
<td>Organizational Matters</td>
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<td>10:00</td>
<td>Coffee and FH Campus Tour</td>
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<tr>
<td>11:00</td>
<td>Additive Manufacturing and Sample Analysis (Lectures)</td>
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<td>12:30</td>
<td>Lunch Break - Sandwich Day</td>
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<tr>
<td>13:30</td>
<td>Additive Manufacturing and Sample Analysis (Workshop)</td>
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<tr>
<td>15:00</td>
<td>Guided Tour “VOESTALPINE Stahlwelt”</td>
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<td>(Public Transport University - Stahlwelt - FH Upper Austria)</td>
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<td>17:30</td>
<td>Welcome Dinner</td>
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**Tuesday, 20 February 2018**

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<tr>
<td>09:00</td>
<td>Inertial Measurement Units for Prosthetics (Lecture)</td>
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<tr>
<td>10:00</td>
<td>Break</td>
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<tr>
<td>10:15</td>
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<tr>
<td>12:30</td>
<td>Lunch Break - Pizza Day</td>
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<tr>
<td>13:30</td>
<td>Healthy Spine - Are you sitting correctly? (Workshop)</td>
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<td>15:00</td>
<td>Break</td>
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**Wednesday, 21 February 2018**

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<td>09:00</td>
<td>Accessing the untapped performance potential of existing lower limb prosthetics technology (Lecture)</td>
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<td>10:30</td>
<td>Break</td>
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<td>10:45</td>
<td>High-tech Limb-Prostheses (Lecture)</td>
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<td>12:30</td>
<td>Lunch Break - Schnitzel Day</td>
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<td>13:30</td>
<td>Visualisation of EMG-Signals which control Myo-Prostheses (Workshop)</td>
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<td>15:30</td>
<td>Break</td>
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<tr>
<td>15:45</td>
<td>Guided Tour “Kepler Universitätsklinikum Med Campus III”</td>
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<td>Hybrid Operation Laboratory for heart surgery with robot based Imaging</td>
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Thursday, 22 February 2018

09:00   Myoelectric Control of Hand-Prostheses (Lecture)
10:00   Break
10:15   Myoelectric Control of Hand-Prostheses (Lecture)
11:15   Break
10:45   Myoelectric Control of Hand-Prostheses (Laboratory)
12:30   Lunch Break - Sandwich Day
13:30   Myoelectric Control of Hand-Prostheses (Laboratory)
15:00   Break
15:15   Myoelectric Control of Hand-Prostheses (Laboratory)
16:15   Break
16:30   “Ars Electronica Center“ (Public Transport FH Upper Austria - AEC)
        “Deep Space 8K - Best of Ars Electronica“
        Highlight Guided Tour “Ars Electronica“
19:00   Farewell Dinner
        (Public Transport AEC - FH Upper Austria)

Friday, 23 February 2018

Activity Day 1 - Technics and Sports
09:00   Bus pick-up from FH Upper Austria
10:00   Guided Tour: BMW-Group Steyr - Engine Plant
13:00   Lunch
14:30   Archery - Sports Centre Breitenstein

Saturday, 24 February 2018

Activity Day 2 - History and Brewery Adventure
09:00   Bus pick-up from FH Upper Austria
10:00   Guided Tour: Historical Site - Concentration Camp Mauthausen
12:15   Lunch
14:30   Guided Tour: Brewery Schloss Eggenberg
Lectures and Workshops

Monday, 19 February 2018

Prof. Dr. Jaroslaw Jacak
University of Applied Sciences Upper Austria (Austria)

Additive Manufacturing and Sample Analysis (Lecture + Workshop)

The modern laboratories in Linz offer a variety of techniques for nanolithography as well as microscopical sample characterisation. In our laboratories, you will get a deeper understanding of techniques like multiphoton lithography, mask less lithography, fluorescence microscopy, atomic force microscopy and spectroscopy. Moreover the laboratory is equipped with an cell culture, equipment for molecular protein and genome analysis as well as advanced equipment for surface characterization. We are using these techniques in several projects applying them for example to analyze aggregation of thrombocytes, for arteria biomimetic etc. Recently, we offer trainee position in several practical courses and experimental bachelor and master works.

Tuesday, 20 February 2018

Prof. Dr. Thomas Haslwanter
University of Applied Sciences Upper Austria (Austria)

Inertial Measurement Units for Prosthetics (Lecture) - Healthy Spine - Are you sitting correctly? (Workshop)

Position and orientation of human subjects (and also of objects like your smartphone) can be measured in different ways: one can use accelerometers, gyroscopes, magnetometers, optical systems, or a number of other devices. Unfortunately, cheap devices are often rather inaccurate, so that a combination of them has to be used in order to achieve reliable results.

In this course we will first introduce the basic measurement devices used for human movement recordings. Then the mathematical foundations required to measure position and orientation will be covered, such as rotation matrices and quaternions.

The accompanying workshop will provide a hands-on experience of working with data from inertial measurement units. Depending on the background of the participants, data will be analysed using Python and/or Matlab. To ensure success in the analysis, routines will be provided that implement the basic analysis steps for the evaluation of the recorded data.

Wednesday, 21 February 2018

Goeran Fiedler, PhD
University of Pittsburgh (USA)

Accessing the untapped performance potential of existing lower limb prosthetics technology (Lecture)

Lower limb loss and the necessity to use prostheses for ambulation is inevitably associated
with a substantial penalty in terms of energy efficiency, safety, and function. While promising research efforts have been dedicated to the development of sophisticated technological solutions to this problem, they have often collided with economic feasibility. A prime example is the first commercially available robotic foot-ankle system that is capable of contributing net energy to the patient’s gait, but is prohibitively expensive for the vast majority of prosthesis users and health insurance systems. A different research direction aims to maximize the performance of already existing prosthesis hardware, with the objective to make those small but inexpensive gains available to a large patient population. This lecture will introduce a number of respective approaches, including the optimization of static alignment, component settings, gait training, and fitting procedures. It will be discussed how generating and implementing the necessary evidence base in this field is challenged by the circumstance that prosthesis provision and fitting is in many respects more an art than a science.

Prof. Dr. Hubert Egger  
University of Applied Sciences Upper Austria (Austria)

High-tech Limb-Prostheses (Lecture)  
A prosthesis is an artificial device that replaces a missing body part, which may be lost through trauma, disease, or congenital conditions. Prosthetic amputee rehabilitation is primarily coordinated by a prosthetist and an inter-disciplinary team of health care. Students attending the Winter School acquire theoretical knowledge with respect to basics in Anatomy, Physiology, Biomechanics, Electrical Engineering and Electronic Systems. The course contributes to improved knowledge and understanding in prosthetic limbs.

Visualisation of EMG-Signals which control Myo-Prostheses (Workshop)  
Based on the theory EMG-Signals will be picked up by surface electrodes from the student’s forearm. Signals are then gained by amplifiers developed at the University of Applied Sciences to make them visible and audible. Additional signal-processing make the signals suitable to control artificial limbs performed in the Lab.

Thursday, 22 February 2018

Prof. Dr. Andreas Schrempf  
University of Applied Sciences Upper Austria (Austria)

Myoelectric Control of Hand-Prostheses (Lecture + Workshop)  
Within this course students will learn to implement a control strategy for a hand prosthesis by means of forearm muscle contractions. In the lecture the basic principles will be discussed and then in turn realized in the laboratory. The implementation of the control strategy will be programmed in C and tested first with the help of Matlab/Simulink. Once the control algorithm works as expected, the implementation will be transferred to the hardware, where students can test their implemented control strategy with their own EMG-signals to operate a real hand prosthesis. The learning outcome of that course includes the following topics: basic filtering techniques for EMG signals, implementation of a control strategy in C by means of a state machine, testing in Matlab/Simulink, transferring a C code to a target hardware platform, acquiring EMG-signals from the forearm, controlling a real hand prosthesis.
Voestalpine Stahlwelt
Come and experience during this 1.5 hours guided tour steel in new, unique ways. Your journey of discovery will take you to the realms of steel production, steel processing, steel products and the triumphs of steel, culminating in the uppermost level dedicated to the Voestalpine Group. The concept behind the exhibition offers a unique interplay between hands-on experience and the acquisition of factual knowledge.

Thursday, 22 February 2018

Ars Electronica Center
The Ars Electronica Center is a place of inquiry and discovery, experimentation and exploration, a place that has taken the world of tomorrow as its stage, and that assembles and presents influences from many different ways of thinking and of seeing things. Join us for a “highlight guided tour” and before that experience the “Deep Space 8K” - a 16 by 9 meters wall and 16 by 9 meters floor projection, laser tracking and 3-D animations. An all-out upgrade of the venue’s technical infrastructure of the Deep Space will enable audiences to enjoy projections at 8K resolution and thus worlds of imagery at a never-before-achieved level of quality.

Friday, 23 February 2018

BMW-Group Steyr Engine Plant
BMW Group Plant Steyr is the company’s largest engine plant worldwide and its diesel engine development centre. Around 4,500 people contribute their passion and innovative capabilities to create the best engines in the world. The plant produces three, four and six-cylinder diesel and petrol engines. More than 6,000 engines are shipped from the plant every day and installed in BMW and MINI cars at vehicle plants worldwide. In 2016, one in two BMWs and every third MINI was powered by an engine from Steyr.
**Friday, 23 February 2018**

**Archery Sports Centre Breitenstein / Kirchschlag**

Kirchschlag is a small municipality in the northern part of Upper Austria. Spend with us a few hours there with delicious food in a typical Austrian restaurant and join us for maybe your first hunting adventure at the Archery Sports Center Breitenstein. Practised archers can embark on the course immediately and independently and beginners can do so with rental bows after a short introduction. You will shoot at different 3D animals. In the last few years, the Bogensportzentrum Breitenstein has established itself as one of the largest archery centres in the German-speaking area. With a 150-m²-sized archery hall open 24/7, three different 3D courses with more than 68 3D targets.

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**Saturday, 24 February 2018**

**Historical Site Concentration Camp Mauthausen**

From 1938 to 1945, the Mauthausen concentration camp was at the centre of a system of over 40 subcamps and was the main site of political, social and racist persecution by the National Socialist regime on Austrian territory. Of a total of around 190,000 people imprisoned here, at least 90,000 were murdered. The Mauthausen Memorial is a former crime scene, a place of memory, a cemetery for the mortal remains of thousands of those murdered here and, increasingly, a site of political and historical education. Its task is to ensure public awareness of the history of the Mauthausen concentration camp and its subcamps, the memory of its victims, and the responsibility borne by the perpetrators and onlookers. At the same time it seeks to promote public critical engagement with this history in the context of its significance for the present and future.

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**Saturday, 24 February 2018**

**Brewery Schloss Eggenberg**

For more than 600 years beer has been brewed at “Schloss Eggenberg”, in the Almtal valley. Discover Upper Austria’s biggest private brewery during a guided tour, let the brewing master introduce you to the art of beer brewing and taste the unique Salzkammergut beer.
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