Welcome!

Whether you arrive from a different canton or country, or are a true and true Zürich native, we are delighted to have you on board as part of the new Masters Program in Biomedical Engineering Program at ETH. The incoming class is international, multi-talented and represents almost every engineering discipline. All of you have shown a commitment to working at the fascinating interface between biology, medicine and engineering.

The next year and a half will be a time of hard work, challenge and, hopefully, great reward. We urge you to take full advantage of the gifted people, outstanding infrastructure and beautiful surroundings which make the ETH so special.
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Structure of the Masters Program

90 credit points are required to obtain a Master of Science ETH in Biomedical Engineering. According to the European Credit Transfer System (ECTS), each credit point corresponds to approximately 25-30 hrs. of work. In most instances, the classroom course work is completed in the first two semesters of the program. The semester project requires a 50% work load and is generally done in the second semester of the program. The masters thesis project is started once all other requirements are completed.

In order to ensure that you finish the program in a timely fashion, it is highly recommended that you plan your course schedule ahead of time, making sure that all of the requirements are fulfilled. Roughly two thirds of the course work should be completed in the first semester and one third in the second semester.

The official regulations of the Masters program ("Studienreglement") can be downloaded from www.master-biomed.ethz.ch/docs/. This document, like all legal documents at the ETH, is written in German.

First steps...

1. Select one of the following tracks.
   - Bioimaging
   - Bioinstrumentation & Signal Processing
   - Biomechanics
   - Molecular Bioengineering

2. Select courses to fulfil the track requirements checking that the times do not overlap and the credit points are sufficient. The course program can be found at www.courses.ethz.ch, Program: Biomedical Engineering Master. A “Program Proposal” form to help plan your course work is available at www.master-biomed.ethz.ch/docs/.

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<th>Requirements for Masters Degree</th>
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<td>Track Courses</td>
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<td>Humanities (GESS)</td>
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<td>Semester Project</td>
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<td>Masters Thesis</td>
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<tr>
<td>Total</td>
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</table>
3. Make an appointment with the faculty advisor in charge of your track and obtain his/her approval of the curriculum you have chosen. If your study plan contains courses which are not listed as accepted electives, the faculty advisor needs to approve this. If you make changes to the plan in the future, a new Study Plan Agreement must be signed by your advisor.

4. You will need to select your two research projects, the “Semester” project and the “Masters Thesis”. Talking to professors who teach your classes, your advisor, or PhD students as well as searching the web pages of individual researchers are good ways to find a project (see pages 14-15). The Institute for Biomedical Engineering publishes Semester and Master projects in Building ETZ Floor F, as well as at www.biomed.ee.ethz.ch. Often research projects are directly supervised by an “Oberassistant” or graduate student, but the official project supervisor is the Professor who is head of the research group in which the work is done. This supervisor needs to sign the two-page Research Plan, which lists the tasks to be completed and the duration of the project. A form for the Project Plan can be found at www.master-biomed.ethz.ch/education/.

The research plan must be approved by your track advisor before the work can be started. Once approved, register the project with Marianne Berg (ETZ F95) and as well as using eEinschreibung.

USEFUL LINKS

- www.ethz.ch: ETH Zürich
- www.ethz.ch/about/location/: ETH building locations
- www.rektorat.ethz.ch: All matters of education
- www.courses.ethz.ch: Master Course Program
- Program: Biomedical Engineering Master
- www.master-biomed.ethz.ch: MSc ETH BME Website
- www.einschreibung.ethz.ch/: Registration for Courses
Bioimaging Track

Faculty Advisors:

Prof. Peter Bösiger (boesiger@biomed.ee.ethz.ch)
Tel: 632-4581 Office: ETZ F96

Prof. Klaas Prüssmann (pruessmann@biomed.ee.ethz.ch)
Tel: 632-6696 Office: ETZ F89

This track prepares you to work in the development and application of state-of-the-art imaging techniques such as magnetic resonance, ultrasound and micro-computed tomography. These methodologies are used to explore physiology and pathophysiology in humans and other living systems. Bioimaging has made enormous contributions to the diagnosis of human illnesses such as cardiac disease, Alzheimer’s disease and osteoporosis. The current course program can be found at www.master-biomed.ethz.ch/education/focus/Bioimage.

Core Courses: Biomedical Engineering A & B
Computer Vision I

Sample Elective Courses:
Computer Vision II
Lasers in Medicine
Biophysics of Neural Computation
Magnetic Resonance Imaging in Medicine
Quantitative Flow Visualization
Quantitative and Analytical Light Microscopy
Computation in Neuromorphic Analog VLSI Systems
Molecular Imaging
Bioinstrumentation & Signal Processing Track

From A. Hierlemann

Faculty Advisor:

Prof. Janos Vörös (janos.voros@biomed.ee.ethz.ch)
Tel: 632-5093 Office: ETZ F82

This track provides in-depth knowledge of the development and use of instruments and signal processing theory to measure physical, physiologic or biologic signals in humans and other living organisms. The development of instrumentation is based on technologies including bioMEMS, micro- and nanosystems, biophotonics, sensors, optics and microfluidics. These technologies are applied to a wide array of instruments and devices including hearing aids, biosensors, labs-on-a-chip, and electrograms. The course program can be found at: www.master-biomed.ethz.ch/education/focus/Bioinstru.
Signal Processing Track

Core Courses:

Biomedical Engineering A & B
Signal and Information Processing: Modelling, Filtering, Learning

Sample Elective Courses:

Biosensors and Bioelectronics
Measuring on the Nanometer Scale
Nanobiotechnology
Microrobotics
Bioinspired Computation and Optimization
Analog Signal Processing and Filtering
Micro- and Nanosystems
Chemical Sensors
Molecular Motors
Computer Simulation of Sensoric Systems
Lasers in Medicine
This track gives you in-depth knowledge about the application of mechanics and measurement methods for understanding the structure and function of biological materials at the organism, organ, tissue, cell, and molecular level. The track includes many application fields ranging from cell biomechanics to fracture fixation and provides education and hands-on research opportunities in theoretical, experimental and computational biomechanics. Biomechanics is a discipline of biomedical engineering which is increasingly influenced by cellular and molecular approaches. The course program can be found at [www.master-biomed.ethz.ch/education/focus/Biomech](http://www.master-biomed.ethz.ch/education/focus/Biomech).

**Core courses:**

Biomedical Engineering A & B  
Orthopaedic Bioengineering or Biomechanics III

**Sample Elective Courses:**

Biomechanics IV  
Trauma Biomechanics  
Multiscale Modelling & Computation  
Continuum Mechanics for Engineers  
Virtual Reality in Medicine  
Finite Elements in Biomechanics  
Bionics and Medical Implants  
Energy Conversion and Transport in Biosystems  
Medical Physics I & II
Molecular Bioengineering

Faculty Advisor:

Prof. Viola Vogel (viola.vogel@mat.ethz.ch)
Tel: 632 0887 Office: HCI F 443

This track concerns the science and engineering behind the next generation of materials. Research topics include advancing the performance of medical implants, engineered tissues, nanoscale drug delivery systems, contrast agents for biomedical imaging and biologically inspired nanomaterials and devices, as well as the interfacing of cells with engineered nanosystems. The current course program can be found at www.master-biomed.ethz.ch/education/focus/Biomaterials.

Elective Courses: (Partial Listing)

- Biomaterial Surfaces: Properties and Characterization
- Biocompatible Materials I: Fundamentals
- Drug Delivery and Targeting
- Biomineralization (BM) and Materials Creation
- Molekulare Biologie und Biophysik III: Proteine, Struktur, Funktion und Engineering
- Materials for Pharmaceutical Applications
- Molecular Motors
- Grundlagen der Biologie IIA-Zellbiologie
- Biocompatible Materials II: Principles in Tissue Engineering
- Frontiers in Nanotechnology and micro/nano Track
- Recent Advances in Protein Engineering
- Organogenesis
- Nanobiotechnology
Associated Faculty Members

Over 30 professors and researchers are associated with the MSc Biomedical Engineering program through their teaching, research and supervision of student research projects. Currently available Master and Semester project topics can be found under the individual websites as well as at www.biomed.ee.ethz.ch.

Peter Bösiger  MRI, Functional Imaging, Brain & Cardiac Imaging  www.mr.ethz.ch

Amedeo Caflisch  Computational Protein Folding, Misfolding and Aggregation  www.biochem-caflisch.unizh.ch

Jürg Dual  Blood Viscometry, Cell Manipulation  www.ifm.ethz.ch

Martin Fussenegger  Biopharmaceutical Manufacturing, Gene Therapy & Networks  www.fussenegger.ethz.ch

Luigi Gallo  Dental Biomechanics  www.dent.unizh.ch/kfs

Jörg Goldhahn  Orthopaedic Biomechanics  www.schulthess-klinik.ch

Heike Hall  Biomaterials, Biomimetic matrices, cell-matrix interactions  www.nanomat.mat.ethz.ch/people/staff/hheike

Ari Helenius  Imaging of viral entry into cells  www.bc.biol.ethz.ch/people/groups/arih/

Andreas Hierlemann  Bioelectronics, electrogenic cells, microelectronics  www.iqe.ethz.ch/pel/

Christofer Hierold  Biomedical Micro- and Nanosystems  www.micro.mavt.ethz.ch

Dimos Poulikakos  Biofluidics, heat and mass transfer in biological systems.  www.ltnt.ethz.ch

Petros Koumoutsakos  Computational modeling and simulations  www.icos.ethz.ch/cse

Roth Kroschewski  Organogenesis in vitro, shape-polarity dependence  www.bc.biol.ethz.ch

<table>
<thead>
<tr>
<th>Name</th>
<th>Field</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hans P. Merkle</td>
<td>Drug Delivery</td>
<td><a href="http://www.galenik.ethz.ch">www.galenik.ethz.ch</a></td>
</tr>
<tr>
<td>Ralph Müller</td>
<td>Bioimaging, Biomechanics, Micro-CT</td>
<td><a href="http://www.biomechanics.ethz.ch">www.biomechanics.ethz.ch</a></td>
</tr>
<tr>
<td>Bradley Nelson</td>
<td>Micro- and nanorobotics</td>
<td><a href="http://www.iris.ethz.ch">www.iris.ethz.ch</a></td>
</tr>
<tr>
<td>Sven Panke</td>
<td>Synthetic Biology, Production of Protein-based Novel Materials</td>
<td><a href="http://www.ipe.ethz.ch">www.ipe.ethz.ch</a></td>
</tr>
<tr>
<td>Klaas Prüssmann</td>
<td>MRI, Image Reconstruction, Radio-frequency Instrumentation</td>
<td><a href="http://www.mr.ethz.ch">www.mr.ethz.ch</a></td>
</tr>
<tr>
<td>Robert Riener</td>
<td>Neurorehabilitation, robotics, virtual reality</td>
<td><a href="http://control.ee.ethz.ch">control.ee.ethz.ch</a></td>
</tr>
<tr>
<td>Markus Rudin</td>
<td>Animal MRI, Molecular Imaging</td>
<td><a href="http://www.biomed.ee.ethz.ch">www.biomed.ee.ethz.ch</a></td>
</tr>
<tr>
<td>Vahid Sandoghdar</td>
<td>Biophotonics</td>
<td><a href="http://www.nano-optics.ethz.ch">www.nano-optics.ethz.ch</a></td>
</tr>
<tr>
<td>Nicholas Spencer</td>
<td>Biotribology, biomolecule-surface interactions</td>
<td><a href="http://www.surface.mat.ethz.ch">www.surface.mat.ethz.ch</a></td>
</tr>
<tr>
<td>Wendelin Stark</td>
<td>Functional Materials, Nanoparticles</td>
<td><a href="http://www.fml.ethz.ch">www.fml.ethz.ch</a></td>
</tr>
<tr>
<td>Andreas Stemmer</td>
<td>Nanotechnology, AFM, Cell Imaging</td>
<td><a href="http://www.nano.mavt.ethz.ch">www.nano.mavt.ethz.ch</a></td>
</tr>
<tr>
<td>Edgar Stüssi</td>
<td>Musculoskeletal Biomechanics</td>
<td><a href="http://www.biomech.ethz.ch">www.biomech.ethz.ch</a></td>
</tr>
<tr>
<td>Gabor Szekely</td>
<td>Medical Image Analysis, Visualization, Virtual Reality</td>
<td><a href="http://www.vision.ee.ethz.ch">www.vision.ee.ethz.ch</a></td>
</tr>
<tr>
<td>Marcus Textor</td>
<td>Multifunctional polymers, Biosensors chips, Drug Carriers</td>
<td><a href="http://www.textorgroup.ch">www.textorgroup.ch</a></td>
</tr>
<tr>
<td>Viola Vogel</td>
<td>Molecular self-assembly, single molecule mechanics</td>
<td><a href="http://www.nanomat.mat.ethz.ch">www.nanomat.mat.ethz.ch</a></td>
</tr>
<tr>
<td>Janos Vörös</td>
<td>Electronic biosensing, Microarray biosensing</td>
<td><a href="http://www.lbb.ethz.ch">www.lbb.ethz.ch</a></td>
</tr>
<tr>
<td>Eckart Zitzler</td>
<td>Biological network analysis and inference</td>
<td><a href="http://www.tik.ee.ethz.ch">www.tik.ee.ethz.ch</a></td>
</tr>
</tbody>
</table>
Biology Core Courses

Cell and Molecular Biology for Engineers
227-0945-00G

Autumn Semester
Tues 8-10 and Wed 13-15

Credit Points: 6

Website: www.master-biomed.ethz.ch/education/bio_courses/Cellmolbiol

This course deals with the strategy of life from a mechanistic and thermodynamic perspective. The course will commence with the evolutionary milestones that gave way to higher multi-cellular organisms and will end with the integrative behaviour of specific cell types. Original scientific manuscripts will supplement the course text aimed at highlighting recent technological advances in cell biology.

Dr. Alfredo Franco-Obregon
franco@biomed.ee.ethz.ch
Office: ETZ F83
Tel: 632-8352
Anatomy & Physiology for Biomedical Engineers
227-0398-00L

Spring Semester
Tues 10-12 and Wed 10-12

Credit Points: 6

Website: www.master-biomed.ethz.ch/education/bio_courses/anatphys

This course provides an introduction into the functions and structural properties of tissues, organs, systems of organs and the human body as an organism. The course Cell and Molecular Biology for Engineers (227-0945-00L) is a prerequisite. The main part of the course is dedicated to the most important systems of organs (respiration, heart and circulation, nervous system, digestion, secretion, skeleton and muscles, immune system, reproductive system and sensory organs). Anatomy and physiology are discussed in a thematic order. Each topic is preceded by some comments concerning evolution and/or embryology. The content of the lectures is adapted for engineers and an emphasis is placed on medical terminology. In a supplementary part of the course, a few topics in applied physiology will be presented.

Dr. Max Casty
mcasty@ethz.ch
castymax@bluewin.ch
BIOMAC Engineering Ltd.
Herterhalde 6
8500 Frauenfeld
Biological Methods for Engineers
227-0949-00P

Instructors:    Dr. Marcy Wong
Office: ETZ F84
Tel: 632-5089
Email: wong@biomed.ee.ethz.ch

Dr. Alfredo Franco-Obregón
Office: ETZ F83
Tel: 632-8352
E-mail: franco@biomed.ee.ethz.ch

Credit Points: 6
Website: www.master-biomed.ethz.ch/education/bio_courses/BioLab
Duration: Jan 7-18 or June 2-13, 2008

The goal of the laboratory course is to give students practical exposure to basic techniques of cell and molecular biology and experience in planning independent, hypothesis-driven experiments.

The laboratory course will cover the following topics:

* Basic laboratory skills and safety
* Cell culture techniques
* Protein analysis
* DNA Isolation and analysis
* RNA Isolation and RT-PCR
The Masters program requires that you take one course (2 credit points) from the Department of GESS (Geistes-, Sozial- und Staatswissenschaften). Courses are given in the fields of history, economics, politics, law, sociology, language, philosophy, the arts, and literature. In order to fulfil the GESS requirement, the course you select must fall under the category “Compulsory Electives GESS”. The complete program can be found under:

www.courses.ethz.ch

Semester: select semester
Department: Humanities, Social and Political Sciences
Programme: Compulsory Electives GESS
Language of Instruction: English (for English language courses)
Click on: search

Sample courses which fulfil the GESS requirement and are offered in English.

- Economic Strategies to Cope with Risks 851-0607-00L
- Literature in English (I) 851-0361-00L 851-0363-00L
- Financial Market Risks 351-0561-00L
- Marketing I 351-0403-00L
- Corporate Sustainability & Technology 351-0387-00L
- Microeconomics 351-0503-00L
- Scientific and Technical English I 851-0835-00L
Navigating ETH

The ETH is a technical university which celebrated its 150th anniversary in 2005. The abbreviation “ETH” stands for “Eidgenössische Technische Hochschule”, or Swiss Federal Institute of Technology. The ETH was founded in 1855 as the Swiss Polytechnic School, and over the years has developed into a first rate research and teaching university that has produced a number of Nobel laureates. The M.Sc. program in Biomedical Engineering is likewise rigorous and demanding, but also very rewarding.

The Swiss Federal Institute of Technology system consists of two Universities, one in Lausanne called EPFL (Ecole Polytechnique Fédérale de Lausanne) and the ETH Zürich. ETH Zürich has two campuses: ETH Zentrum (in Zürich’s city center) which includes the main building that houses the administration and most engineering departments, and ETH Hönggerberg where the departments of Physics, Biology, Chemistry, Materials Science, Civil Engineering, and Architecture are located. The two campuses are about 20 minutes apart and are linked by free shuttle buses during the semester (www.student.ethz.ch/pages/de/studierendeServices.jsp). By public transportation the Hönggerberg campus can be reached by Bus 69 and 80. Buildings on the Hönggerberg campus start with the letter “H”.

There are 15 Departments of study at the ETH. Each Department is composed of smaller units or Institutes. The Institute for Biomedical Engineering (www.biomed.ee.ethz.ch) belongs to the Department of Information Technology and Electrical Engineering (D-ITET) and administers the Masters Program in Biomedical Engineering.
The ETH runs on the semester system. Classes last for 45 minutes and start 15 min. after the hour (ETH Zentrum) / 15 min. before the hour (ETH Hönggerberg), respectively. Classes can be found online (www.courses.ethz.ch). There are different categories of classes. The 4 most important ones are:

V – Vorlesung (lecture course)
U – Übungen (exercises)
G – Gruppenunterricht (group instruction, combining V and U)
P – Praktikum (practical / lab course)

Other useful information about studying at the ETH is found at http://www.ethz.ch/students.
Language

Understanding some German will make your life in Zürich infinitely easier. While many people speak English and most Masters level courses are offered in English, much of the web-based information and forms have not yet been translated. Furthermore, there are many terms and jargon unique to the Swiss University system which have no real English translation. “German as a Foreign Language” courses are offered at all levels from the Language Center (www.sprachenzentrum.unizh.ch). There is an intensive 3-week long course held during the semester breaks. A basic knowledge of German is a prerequisite for this course. D-GESS, the Department of Humanities, also offers courses in a variety of languages including German, English, French, Italian, Spanish, Russian, Arabic, Japanese, and Chinese.

Program-Affiliated Departments & Faculties

D-ITET       Information Technology & Electrical Engineering
D-MAVT  Mechanical & Process Engineering
D-MATL  Materials
D-CHAB  Chemistry & Applied Biosciences
D-INFK  Computer Science
D-PHYS  Physics
D-BIOL  Biology
Medical Faculty of University of Zürich
Exams and Grades

The system of exams is different than in many other universities. Students may be required to hand in a certain number of problem sets and or attend a certain percentage of the lectures to prove their involvement in a class. Upon successful completion of the class, the student will be given a “Testat” which is the status needed to register for and take the exam. Exams are either held at the end of the semester (“Semesterendprüfung”) or in the official exam period (“Prüfungssession”). The latter allows time for the student to review the material and study for the exams. It is your responsibility to register for exams you will be taking. The academic calendar can be found under: www.rektorat.ethz.ch/akad_kal_termine

The grading scale ranges from 1 (the worst) to 6 (the best). The passing grade is 4. Once the exam has been passed, the credit points for the corresponding class will be awarded. A passing grade is required for all Track and Biology Core Courses, except for the laboratory, which is pass/fail.
Zürich is consistently rated as one of the best places in the world to live. The city is situated on the beautiful lake of Zürich with the mountains less than an hour away. Zürich is relatively clean and safe and has an excellent public transportation system. The city has an international flair and offers an active cultural and nightlife. Most Swiss are multi-lingual and English is often the language of choice. Although German is not required for the Masters program, some knowledge will make navigating the city and the university much easier.

The ETH offers a wide variety of sports, music, recreational and continuing education opportunites. An overview can be found at www.ethz.ch/intranet/life/.

The Association of Scientific Staff at ETH (AVETH) publishes a Survival Guide for new ETH students. Although this Guide is primarily oriented towards PhD Students, it contains useful information on all matters of ETH student life. The guide is for sale for 5 Swiss Francs at SOL G9, Sonneggstr. 33 (seket@aveth.ethz.ch) or can be downloaded at http://www.aveth.ethz.ch/sg/sg_en.html. The AVETH also supports a network for international students at www.international.ethz.ch
Useful Contacts

AMIV
Organization of Mechanical and Electrical Engineers
www.amiv.ethz.ch
Used books, exam preparation, old exams, course scripts, tutoring

Registration and Administration
www.rektorat.ethz.ch, www.rektorat.ethz.ch/students/admin
Rektoratskanzlei, ETH HG (main building) F19

D-ITET Department Secretary, Marcel Kreuzer
Tel: 044/632 50 02, kreuzer@ee.ethz.ch

Food
The student cafeteria or Mensa is probably the cheapest place to eat in Zürich, next to home cooking. The menus and locations are found at www.mensa.ethz.ch, www.mensa.unizh.ch

Sports
www.asvz.ch
Offers facilities and courses for sports of all kinds

Housing
www.wohnen.ethz.ch
www.woko.ch
Free papers i.e. Tagblatt, 20 Minuten

Language
Language classes including German as a Foreign Language
www.sprachenzentrum.unizh.ch

Student Exchange
Students interested in spending a semester abroad
www.mobilitaet.ethz.ch

Money
Scholarship Office, HG FO 21.1
www.rektorat.ethz.ch/students/finance/index_EN

Jobs
Electronic job search engine for PhD positions and industry positions in Switzerland and abroad
www.telejob.ch

Counselling
Free, confidential, professional counselling service for ETH students.
Wilfriedstrasse 6, 044/634 22 80, pbs@zuv.unizh.ch,
www.pbs.uzh.ch

Books
Student bookstore or Polybuchhandlung, MM B96 or HPI E16.1
www.polybuchhandlung.ch
www.nebis.ch (Libraries)

Travel
Switzerland has an excellent, though expensive, network of public transportation.
www.vbz.ch - trams & buses in greater Zürich area
www.sbb.ch - train schedule

Weather
www.meteoswiss.ch

Zürich City Map

Zürich Info
Free Broschures in English on all aspect of Life in Zürich
www.welcome.zh.ch

Swiss Maps
map.search.ch
Master/Semester Projects 2007

Siddhartha Jha
Multitrode recordings in the singing zebra fish

Raymond Ochsenbein
Development of a computational model for prediction of the change in the structural response of failed human vertebrae

Samuel Basler
Automation of a biomechanical testing device for image-guided failure assessment of bone-implant systems

Denis Dhiver
Micro/Nano Pattern Reproduction

Basem Dokhan
Feasibility study for two respiration measuring principles

Aikaterini Dikaiou
Implementation of the parallel imaging technique GRAPPA for small animal MRI

Yi Zeng
Development of multi-slice and/or 3D perfusion imaging based on arterial spin-labelling

Patrizia Fisher
Correction of metal-related artifacts in micro-CT images

Robert Nguyen
3D dynamic modeling and control of functional electrical stimulation assisted arm free quiet standing
Bertram Kölsch
Flow-induced endothelial cell orientation on/within different modified 3D fibrin matrices

Alexandre Lamargnac
Modeling pH spatial dispersion at the interface electrode/electrolyte

Emily Manning
Motion compensation in kt SENSE accelerated cardiac perfusion imaging

Chia Huei Tan
DNA-tagged vesicles for protein microarray applications

Martin Wälti
Role of wall stress in the pathogenesis of spontaneous dissection of the carotid artery

Leilei Wu
Visualization of deformations in the orbit and the heart using motion encoded MR images

Philipp Spycher
Cargo-transport by molecular shuttles in micro-channels
Contact

Marcy Wong, Program Coordinator
wong@biomed.ee.ethz.ch
www.master-biomed.ethz.ch
www.ethz.ch