

# Scientific Program

of the

## 13<sup>th</sup> Vienna International Workshop on Functional Electrical Stimulation



Vienna, Austria, September 23<sup>rd</sup>-25<sup>th</sup>, 2019

[fesworkshop.org](http://fesworkshop.org)

## GENERAL INFORMATION

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The triennial "Vienna International Workshop on Functional Electrical Stimulation" provides a platform for researchers to present and discuss their recent work whilst visitors can expect a representative and actual overview of the state of the art of FES.

### Conference venue

Haus der Ingenieure  
Eschenbachgasse 9, 1010 Vienna  
<https://www.palais-eschenbach.at/>

### National organizers

Austrian Society for Biomedical Engineering  
"FES group of the Austrian Society for Biomedical Engineering"  
W.Mayr, M.Bijak, M.Pichler, H.Lanmüller, D.Rafolt

### Contact address

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A-1090 Vienna, Austria                      e-Mail: [office@fesworkshop.org](mailto:office@fesworkshop.org)

### Conference language

The official language of the conference is English

### Dates

Come together Coffee	23. Sept. 2019	08:30 - 09:30
Scientific program	23. Sept. 2019	09:30 - 18:00
Scientific program	24. Sept. 2019	08:00 - 18:00
Conference Dinner	24. Sept. 2019	18:00 - 23:00
Post Conference Course	25. Sept. 2019	09:00 - 16:00

### Registration fee

Conference	€ 350,00 / 320,00*
Day Ticket**	€ 140,00
Post Conference Course	€ 120,00

\* Members of ÖGBMT or IFESS in good standing,  
Participants of the "2. Fachtag Elektrotherapie"

\*\* Does not include social activities in the evening

## GENERAL INFORMATION

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### Accompanying persons

*Conference Dinner* € 90,00 24. Sept. 2019

### Methods of payment

*Bank transfer, Credit card transfer  
or directly at the registration desk (credit card – NO CASH)*

### The registration fee for the whole conference includes

*Come together coffee  
Coffee breaks, Lunch  
Conference dinner  
Conference proceedings*

*Day tickets include: Scientific program, coffee breaks, lunch and conference proceedings*

### Registration Desk

*Open throughout the conference:*

<i>Monday, 23. Sept. 2019</i>	<i>08:00 - 17:00</i>
<i>Tuesday 24. Sept. 2019</i>	<i>08:00 - 18:00</i>
<i>Wednesday 25. Sept. 2019</i>	<i>08:30 - 14:00</i>

### Conference Dinner

*24. Sept. 2019  
Berghotel Tulbinger Kogel  
Tulbingerkogel 1, 3001 Tulbing  
[www.tulbingerkogel.at](http://www.tulbingerkogel.at)*

### Commercial exhibition

*Facilities for exhibition and commercial product presentations are available - interested companies please contact the secretary.*

### Oral presentation

*Time: 15 minutes*

*(10 minutes presentation and 5 minutes discussion)*

### Presentation media

*Beamer and PC for PowerPoint presentations*

*(USB memory stick)*

*Speakers should submit their media 30 minutes prior to the start of their session at the slide desk.*

### Poster presentation

*The posters should be exhibited at the assigned poster board during the whole conference. All participants are encouraged to contact the authors during the coffee breaks.*

*Paper size A0, portrait.*

### Proceedings of the conference

*The proceedings with full-length papers will be available at the beginning of the workshop.*

### Detailed information

*Please find further information at the official conference homepage:  
[fesworkshop.org/13th-workshop-2019](http://fesworkshop.org/13th-workshop-2019)*

Gad Alon

Brian Andrews

Christine Azevedo Coste

Manfred Bijak

Radu Ciupa

Mihaela Cretu

Glen Davis

Thordur Helgason

Ursula Hofstoetter

Klaus Peter Koch

Hermann Lanmüller

Johannes Martinek

Karen Minassian

Dejan Popović

Frank Rattay

Martin Reichel

Matthias Krenn

Janez Rozman

Stefan Sauermann

Thomas Schauer

Martin Schmoll

Erika G. Spaich

Thomas Stieglitz

Paul Taylor

José Luis Vargas Luna

Michael Willand

## Monday 23.09.2019

### Key

#### *Keynote Lecture:*

Chairperson: Gad Alon (Maryland, USA)

09:30 – 10:00 Ines Bersch-Porada (Lucern, Switzerland)  
APPLICATIONS OF FES IN MOVEMENT REHABILITATION IN SCI

### Session 1

#### *Restoration of movement*

Chairpersons: Milan Dimitrijevic (Houston, USA)  
Justin Brown (Harvard, USA)

- 10:00 Milan Dimitrijevic (Houston, USA)  
INTRODUCTION TO THE TOPIC
- 10:05 Andreas Schicketmueller et al (Magdeburg, Germany)  
SENSOR BASED MOVEMENT DETECTION FOR FUNCTIONAL  
ELECTRICAL STIMULATION DURING END-EFFECTOR GAIT  
REHABILITATION
- 10:20 Dejan Popović et al (Belgrade, Serbia)  
THE FINITE STATE CONTROL OF STIMULATION SYNERGY BASED ON  
DATA FROM THE INSTRUMENTED SHOE INSOLE
- 10:35 Marion Groperrin et al (Lausanne, Switzerland)  
AN EMG-CONTROLLED SYSTEM COMBINING FES AND A SOFT  
EXOSKELETON GLOVE FOR HAND REHABILITATION OF STROKE  
PATIENTS
- 10:50 Ursula Hofstoetter et al (Vienna, Austria)  
NONINVASIVE SPINAL CORD STIMULATION IMPROVES WALKING  
PERFORMANCE IN AN INDIVIDUAL WITH MULTIPLE SCLEROSIS
- 11:05 Max Haberbusch et al (Vienna, Austria)  
INVESTIGATION ON THE INTERACTION OF MONOSYNAPTIC AND  
POLYSYNAPTIC ACTIVITY UNDERLYING POSTERIOR ROOT REFLEXES
- 11:20 Guðrún Magnúsdóttir (Reykjavík, Iceland)  
COMPARISON OF RESULTS FROM A SPASTICITY ASSESSMENT OF THE  
ANKLE JOINT USING THE TARDIEU SCALE AND EMG ACTIVITY

- RECORDED SIMULTANEOUSLY IN STROKE PATIENTS
- 11:35 Katsuhiko Nishino (Akita, Japan)  
SPINAL CORD STIMULATION FOR ENHANCING MOTOR RECOVERY  
AFTER STROKE AND IMPROVING CHRONIC PAIN: IDENTIFYING  
RESPONDERS USING KETAMINE AND MAGNETIC STIMULATION
- 11:50 Justin Brown (Harvard, USA)  
RECONSTRUCTIVE NEUROSURGERY FOR RESTORATION OF FUNCTION  
FOLLOWING SCI
- 12:05 Milan Dimitrijevic (Houston, USA)  
SUMMARY
- 12:15-13:30 Lunch
- Special  
Session 2**
- WEARPLEX: European multidisciplinary Research and  
Innovation Action on WEARable multiPLEXed biomedical  
electrodes***
- Chairpersons: Thierry Keller (San Sebastian, Spain)  
Russel Torah (Southampton, UK)
- 13:30 Milos Kostic et al (Belgrade, Serbia)  
INTRODUCTION OF EU-H2020 PROJECT WEARPLEX - WEARABLE  
MULTIPLYED BIOMEDICAL ELECTRODES
- 13:42 Russel Torah (Southampton, UK)  
PRINTED ELECTRODE STRUCTURES FOR BIO-POTENTIAL MONITORING  
IN WEARABLE E-TEXTILE GARMENTS
- 13:54 Erik Hernandez Jimenez (San Sebastian, Spain)  
CLASS: PLATFORM FOR STIMULATION AND RECORDING VIA  
WEARABLE MULTIPLYED ELECTRODES
- 14:06 Matija Strbac (Belgrade, Serbia)  
CUSTOM DESIGN OF MULTI-ELECTRODE ARRAYS FOR STIMULATION  
AND RECORDING APPLICATIONS
- 14:18 Peter Andersson Ersman (Norrköping, Sweden)  
SCREEN PRINTED ORGANIC ELECTROCHEMICAL TRANSISTORS FOR  
RECORDING AND STIMULATION APPLICATIONS

*Scientific Program Monday 23<sup>rd</sup>, Sept. 2019*

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- 14:30 Luis Pelaez Murciego (Aalborg, Denmark)  
MUSCLE PATTERNS IN HIGH-DENSITY EMG RECORDED DURING GRASPING IN DIFFERENT ARM POSITIONS
- 14:42 Nikola Perinka (Leioa, Spain)  
DEVELOPMENT OF NEW FUNCTIONAL INKS FOR BIO-MONITORING APPLICATIONS
- 14:54 Abiodun Komolafe (Southampton, UK)  
INTEGRATION OF FLEXIBLE CIRCUITS IN TEXTILES FOR WEARABLE HEALTH MONITORING
- 15:06 Jenni Isotalo (Oulu, Finland)  
EXPERIENCES IN SCALE-UP MANUFACTURING OF PRINTED MEDICAL DEVICES
- 15:18 Russel Torah (Southampton, UK)  
INTEGRATION OF WEARPLEX TECHNOLOGY AND DEVELOPMENT OF ALPHA PROTOTYPES OF WEARPLEX ELECTRODES
- 15:30-16:00 Coffee Break**



**Session 3**

***Aging, dystrophic and denervated Muscle***

Chairpersons: Stanley Salmons (Liverpool, UK)  
Markus Gugatschka (Graz, Austria)

- 16:00 Ugo Carraro et al (Padova, Italy)  
HOME BASED FUNCTIONAL ELECTRICAL STIMULATION FOR EARLY-AGING AND AGING, A NARRATIVE REVIEW
- 16:15 Markus Gugatschka (Graz, Austria)  
FES FOR TREATMENT OF AGE RELATED LARYNGEAL MUSCLE ATROPHY
- 16:30 Feliciano Protasi (Chieti, Italy)  
TREATMENT OF CENTRAL CORE DISEASE WITH FUNCTIONAL ELECTRICAL STIMULATION: A CASE REPORT.
- 16:45 Berit Schneider-Stickler, et al (Vienna, Austria)  
SELECTIVE SURFACE STIMULATION IN UNILATERAL VOCAL FOLD PARALYSIS (UVFP)
- 17:00 Gerd Fabian Volk et al (Jena, Germany)  
LONG-TERM HOME-BASED SURFACE ELECTROSTIMULATION IS USEFUL TO PREVENT ATROPHY IN DENERVATED FACIAL MUSCLES.
- 17:15 Gad Alon (Maryland, USA)  
OBSTETRIC BRACHIAL PLEXUS INJURY (OBPI): IS FUNCTIONAL ELECTRICAL STIMULATION (FES) A VIABLE INTERVENTION OPTION?

**ÖGBMT**

***Talk of Stefan-Schuy prize winner***

***General Assembly***

- 18:00 Mathias Tschaikner (Graz, Austria)  
Development of a Single-Site Device for Conjoined Glucose Sensing and Insulin Delivery in Type 1 Diabetes Patients

followed by General assembly ÖGBMT

## Tuesday 24.09.2019

### Key

#### *Keynote Lecture*

Chairperson: Thomas Schauer (Berlin, Germany)

08:00 – 08:30 Francesco Moscato (Vienna, Austria)  
PERSPECTIVES OF ADDITIVE MANUFACTURING FOR PROSTHETIC INSTRUMENTATION

### Session 4

#### *Advanced Biosignal Analysis*

Chairpersons: Paolo Gargiulo (Reykjavík, Iceland)  
Martin Schmoll (Vienna, Austria)

08:30 Lukas Wiedemann et al (Auckland, New Zealand)  
DECOMPOSITION OF HDEMG DATA OF A CHILD WITH SPASTIC CEREBRAL PALSY: A CASE STUDY PRE AND POST BONT-A TREATMENT

08:45 Paolo Gargiulo et al (Reykjavík, Iceland)  
USE OF HIGH DENSITY EEG TO ASSESS SCHIZOPHRENIC PATIENTS UNDERGOING TMS TREATMENT: N100-P300 ERP COMPLEX

09:00 Manfred Bijak et al (Vienna Austria)  
SKIN IMPEDANCE IS A RELIABLE PARAMETER FOR AROUSAL MONITORING (STRESS MONITORING)

09:15 Halldór Kárason et al (Reykjavík, Iceland)  
FREQUENCY ANALYSIS OF EMG SIGNALS FROM THE TRICEPS SURAE MUSCLE IN ACHILLES TENDON TESTS BY STROKE PATIENTS IN TSCS TREATMENT.

09:30 Martin Baumgartner et al (Vienna, Austria)  
EFFECTS OF MUSCLE FATIGUING SEMG DATA ON THE CLASSIFICATION ACCURACY OF A NONLINEAR MYOELECTRIC CONTROL CLASSIFIER

09:45 Weerayot Aramphianlert et al (Vienna, Austria)  
SURFACE EMG BASED MUSCLE FATIGUE LEVEL ESTIMATION

10:00-10:30 **Coffee Break**

**Session 5**

***Early Career Panel Discussion***

Chairpersons: Johannes Martinek (Vienna, Austria)  
Matthias Scherer (Vienna, Austria)

10:30 – 12:00 Details t.b.a.

12:00-13:30 Lunch

**Key**

***Keynote Lecture***

Chairperson: Nico Rijkhoff (Aalborg, Denmark)

13:30 Sean Doherty (London, UK)  
NEUROMODULATION OF NEUROGENIC BLADDER DYSFUNCTION

**Session 6**

***Parameters and Technology***

Chairpersons: Jonathan Jarvis (Liverpool, UK)  
Hermann Lanmüller (Vienna, Austria)

14:00 Nico Rijkhoff et al (Aalborg, Denmark)  
A PERCUTANEOUS ELECTRODE FOR DORSAL GENITAL NERVE  
STIMULATION; COMPARISON WITH A SURFACE ELECTRODE

14:15 Janez Rozman et al (Ljubljana, Slovenia)  
MULTI-CHANNEL TRANSCUTANEOUS AURICULAR NERVE  
STIMULATION

14:30 Steffen Eickhoff et al (Liverpool, UK)  
INFLUENCE OF ELECTRODE CONFIGURATION ON THE EFFECT OF  
SUBTHRESHOLD PRE-PULSES: AN EXPLANATION FOR TWO DECADES  
OF CONFLICTING DATA

14:45 Narrendar Ravichandran et al (Auckland, New Zealand)  
A COMPUTATIONAL MODEL FOR NEUROMUSCULAR ELECTRICAL

- 15:00 STIMULATION - FEATURING EXCITATION CONTRACTION DYNAMICS  
Markus Valtin et al (Berlin, Germany)  
FES TESTBED FOR MULTI-CHANNEL TRANSCUTANEOUS STIMULATION SYSTEMS
- 15:15 Constantin Wiesener et al (Berlin, Germany)  
CURRENT-CONTROLLED STIMULATOR WITH VARIABLE HIGH VOLTAGE GENERATION
- 15:30 Eduardo Villar Ortega et al (Bern, Switzerland)  
HIGH-FREQUENCY TRANSCUTANEOUS CERVICAL ELECTRICAL STIMULATION: A PILOT STUDY
- 15:45 Christoph Kast et al (Vienna, Austria)  
SHORT IMPULSE STIMULATION FOR PREDOMINANT ACTIVATION OF PROPRIOCEPTIVE AFFERENTS

**16:00 – 16:30 Coffee Break**

***Special  
Session 7***

***Hybrid systems for exercising cyclic functional movements***

Chairpersons: Dejan Popović (Belgrade, Serbia)  
Jozsef Laczko (Budapest, Hungary)

- 16:30 Dejan Popović (Belgrade, Serbia)  
THE ROLE OF FUNCTIONAL ELECTRICAL STIMULATION IN HYBRID SYSTEMS FOR REHABILITATION
- 16:45 Mayr Winfried (Vienna, Austria)  
STIMULATION PARAMETERS FOR CYCLING IN PERSONS WITH DENERVATED AND ATROPHIED MUSCLES DUE TO THE INJURY OF THE CENTRAL NERVOUS SYSTEM
- 17:00 Laczko Jozsef (Budapest, Hungary)  
THE IMPORTANCE OF MODELING FOR CONTROL OF ELECTRICAL STIMULATION FOR CYCLING
- 17:15 Lana Popović Maneski et al (Belgrade, Serbia)  
FES CYCLING IN PERSONS WITH PARALYZED LEGS: FORCE FEEDBACK FOR SETUP AND CONTROL

- 17:30**            Alexander Kohlreider (Austria)  
THE DEVELOPMENT OF ROBOTIC PLATFORMS FOR SUPPORTING THE  
EXERCISE OF PARALYZED LEGS
- 17:45**            Mariann Percze-Mravcsik et al (Pecs, Hungary)  
TRICYCLING BY FES OF QUADRICEPS MUSCLES LEADS TO INCREASED  
CYCLING SPEED OVER SERIES OF TRAININGS OF PERSONS WITH  
FLACCID PARAPLEGIA
- 18:00**            **Conference Dinner**

## **Wednesday 25.09.2019**

### **PCC 1**

#### *Post-Conference Courses*

09:00 - 10:30 **Introduction the Workshops**

10:30 – 11:00 **Coffee Break**

11:00 - 12:00 **Introduction to Exhibition**

12:00-13:00 **Lunch**

13:00 – 16:00 **Workshops**  
are in the same room, you switch any time according to your interest

### **PCC 2a**

#### *Additive Manufacturing: In the scope of FES and Rehabilitation*

Ewald Unger, Francesco Moscato

Additive Manufacturing (AM), colloquially known as 3D-Printing, has been established in our hospital in the past years. By definition this technology can produce three-dimensional parts by deposition and binding of multiple materials on a layer-by-layer basis.

AM technology can be categorized in different processes depending on the material used, ranging from polymers, ceramics as well as metals and biological materials, and on the binding method, ranging from gluing, to photopolymerization and laser melting.

Within our post-conference workshop we will give you an overview about our 3d-printing infrastructure, which is based on the project "Additive Manufacturing for Medical Research, M3dRES", founded by the Austrian Research Promotion Agency (FFG).

You will have a backstage view to our work, running projects and hurdles to establish a 3D-Laboratory inside a hospital. You will have the possibility to get an overview about the typical workflow to create medical models based on any medical imaging during an hands on training by using our rendering software USL-Mimics (Materialise).

We will be pleased to help you designing your own patient-specific application in FES.

Looking forward to see you at the workshop!

**PCC 2b**

***FES in Spinal Cord Injury***

Ines Bersch-Porada, Jose Luis Vargas Luna, Winfried Mayr

FES provides a whole spectrum of options for support of movement rehabilitation in spinal cord injury. Due to individualization of the residual profile of motor control after injury and functional changes over time personalization, based on regular assessment, is essential for intervention planning and follow-up monitoring. Further, available and affordable equipment is to be selected and applied in best possible compliance with daily activities of the user.

The course focuses on non-invasive options and will discuss and demonstrate examples for amelioration of spasticity, support of restoration of movement, maintenance of cardiovascular fitness, and prevention of pressure sores and osteoporosis. Technical, physiological and clinical aspects of stimulation of afferent and efferent nerves as well as direct stimulation of denervated muscles will be addressed in view of realistic benefit, safety and limitations. A theoretical introduction part and subsequent application oriented hands-on demonstrations will convey basic practice and have room for continuous interactive discussion.

**PCC 2c**

***FES of Upper Extremities***

Dejan Popović, Lana Popović Maneski

The workshop is structured to have a theoretical introduction and subsequent application oriented hands-on demonstrations. The workshop is planned to include continuous interactive discussion.

The workshop will focus on non-invasive options for the control of paralyzed arm-hand complex after the central nervous system lesion (brain lesion, cervical lesion of the spinal cord, and similar).

The workshop starts with theory describing the principle of the operation of functional activation of paralyzed muscles by means of electrical field and differences between the use of transcutaneous and implantable technologies. The results on the efficacy of FES augmented manipulation and grasping, with the emphasis on what were the limitations of the systems applied, will follow. The main questions that will be answered deal with methods to provide sufficient selectivity, minimize muscle fatigue, and have the control that matches the needs of users.

The practical part will be a demonstration of the strategies and limitations of the surface activation of arm muscles to support the exercise, manipulation and exercise. The presentation will include the activation of sensory pathways for possible feedback applications. An interesting example will be described where the FES technology can be used for the reduction of tremor.

The practical part will be with the new stimulators MOTIMOVE (<https://www.3-x-f.com/products.php>) and UNAFET stimulators used in clinical trials for therapy persons after stroke and spinal cord lesion at the cervical level.



**PCC 2d**

***Electrode suit for afferent multi-channel nerve-stimulation  
for augmentation of movement in children with CP***

Fredrik Lundquist

The aim of the course is to give insight and knowledge in how multi-channel afferent nerve stimulation can be a helpful tool in augmenting and improving movement and body position in children suffering from cerebral palsy. The whole-body system Mollii gives the rehabilitation specialists the possibility to pinpoint, and work with, specific steps in the complex process of pediatric neurorehabilitation. Pre/post stimulation videos of children using the Mollii-electrode suit system will be presented and discussed during the course.

*We acknowledge the support by:*

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Artificial  
Organs



**Edited by:**

**Paul S. Malchesky, D.  
Eng.**

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journal.asp?ref=0160-564X](http://www.wiley.com/bw/journal.asp?ref=0160-564X)

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