### **WEARRACON CONFERENCE - 25 OCTOBER**

Dr. Christophe Maufroy, Fraunhofer IPA, Germany

Prof. Nicola Vitiello, Scuola Superiore Sant'Anna

movement assistance, rehabilitation and augmentation.

#### **CONFERENCE OVERVIEW**

**PROGRAM WEARRACON - 26 OCTOBER** 

Room 14, Hall 1, 1st Floor 09.00 am - 09.30 am | Arrival and registration

09.30 am - 10.00 am | Welcome speech



Photo: Dr. Christophe Maufroy

#### 10.00 am - 11.00 am | Keynote speech: Wearable Robotics at The BioRobotics Institute

Ageing population affects society welfare sustainability. The ageing of the population is one of the most critical challenges current industrialized societies will have to face in the next years, and threatens the sustainability of our social welfare. Among many diseases, gait disorders are common and often devastating companions of ageing, leading to reductions in quality of life and increased mortality. This presentation will introduce the research activities carried out at The BioRobotics Institute of Scuola Superiore Sant'Anna in the field of wearable robots for human

Photo: Nicola Vitiello

11.00 am - 11.30 am | Coffee break

### Room 14, Hall 1, 1st Floor

### Control of active exoskeletons for industrial applications

Session A1 - Exoskeletons and Exosuits Technologies I

11.30 am - 12.00 am

Dr. Jesús Ortiz, Istituto Italiano di Tecnologia

**Abstract:** Photo: IIT The successful implementation of active exoskeletons in industrial settings hinges on their ability to effectively adapt to a wide range of tasks and scenarios. Achieving this versatility relies heavily on the diversity and precision of their control strategies. In this presentation, we will delve into our latest research on control strategies for industrial active exoskeletons that assist the lower back, shoulders, and elbows, highlighting their potential to improve workplace safety and

Development of wearable exoskeletons for effective human motion assistance



efficiency.

12.00 am - 12.30 pm

**Prof. Shaoping Bai, Aalborg University** 

**Abstract:** Photo: s. bai This talk will provide a brief overview of

exoskeleton development at the Exoskeleton Lab, AAU, addressing research challenges in the assistive exoskeleton design and development. Research issues including innovative mechanism design, physical human-exoskeleton interaction, sensing and control, and performance assessment will be covered. Some novel designs and sensing methods will be introduced, along with some examples of exoskeletons for rehabilitations and for workplace assistances.

Quantification of the mechanical properties of the physical human-exoskeleton interface - Results of a subject study investigating upper arm interfaces.



12.30 pm - 01.00 pm

Jonas Schiebl, Fraunhofer Institute for Manufacturing **Engineering and Automation IPA** 

Photo: Jonas Schiebl

Abstract: Forces and torques acting in physical

human-exoskeleton interfaces cause relative movement of the exoskeleton with respect to the human body. Knowledge of the quantitative relationships between acting loads and the resulting relative displacements could enable more precise model-based analyses that can more accurately represent the biomechanical interaction between human and exoskeleton. We introduce an experimental setup that can be used to record such mechanical interface data experimentally. The results from a first pilot study on test subjects' upper arms including the resulting interface stiffnesses for translational and rotational motions are presented.

## Session B1 - Assessment and Human Factors I

Evaluation of passive and active exoskeletons using wearable sensors and Digital Human Models

Prof. Serena Ivaldi,



Photo: Emile Loraux

Room 15, Hall 1, 1st Floor

11.30 am - 12.00 am

**INRIA** 

Abstract: The talk overviews the methodologies we

developed to evaluate the use of passive and active exoskeletons, including wearable sensors and Digital Human Models. In the case of passive exoskeletons, we also discuss the deployment in a hospital for assisting medical staff.

### Lessons Learned from Evaluating Industrial Exoskeletons



Ambach

12.00 am - 12.30 pm

Lennart Ralfs, Universität Innsbruck

Abstract: The lecture addresses a mixed-method

approach to the evaluation of industrial exoskeletons, which enables a multi-layered analysis of the

effects of exoskeletons and the work processes. For this purpose, exemplary study results address the biomechanical effect, ergonomics, or acceptance and usability of exoskeletons. The many years of knowledge and experience are summarized in recommendations for action and a guideline that can contribute to the targeted practical use of exoskeletons in industrial applications.

### The assessment of the Exo4Work shoulder exoskeleton



Photo: Sander De

Bock

Dr. Sander De Bock,

12.30 pm - 01.00 pm

Vrije Universiteit Brussel

Abstract: Within the Exo4Work project, a new passive

shoulder exoskeleton was designed. Subsequently, we tested how the support of the exoskeleton affects muscle activity and fatigue, and how it influences the performance during overhead work.

## 01.00 pm - 02.30 pm | Lunch break

02.30 pm - 04.00 pm | Poster session

# CCD South, 1st Floor

# 04.00 pm - 04.30 pm | Coffee break

Room 14, Hall 1, 1st Floor

### Session A2 - Modeling & Simulation Simulation-based conceptual design of exoskeleton actuators



Photo: Aalborg

University

04.30 pm - 05.00 pm

Prof. John Rasmussen, **Aalborg University** 

**Abstract:** 

late stages of the design process where the conceptual design is determined and most cost committed. However, a special mathematical structure of the musculoskeletal analysis problem used to simulate the influence of exoskeletons on the human body allow us to use the simulation to directly point out optimum configurations of actuators in the early stages of the design cycle. This is demonstrated using a few examples

CAE simulation is usually employed in the

### Model-based adaptive control of trunk exoskeletons: towards bio-protective robotic technologies



from a box lifting task.

05.00 pm - 05.30 pm **Prof. Massimo Sartori,** 

University of Twente

**Abstract:** 

Photo: University of Twente

This talk will provide an overview of the research my group is doing, specifically on

how we're aiming to close the loop between human biology and robotic technology ultimately for protecting biological tissues from injuries in assistive and occupational domains. The talk will present advances at the intersection between physiologically correct musculoskeletal modelling, realtime model-based control and wearable robotic technologies with a focus on the human trunk.

### **DigitalExonomics - Digital Work Planning and Ergonomic** Assessment for the Use of Industrial Exoskeletons

05.30 pm - 06.00 pm

Prof. Lars Fritzsche,



imk Industrial Intelligence GmbH

06.00 pm | Come together with BASI

**Abstract**:

"DigitalExonomics", founded by the German

This presentation will give insights to a Industrial current research project named Intelligence GmbH

develop and validate methods for the digital testing and assessment of exoskeletons in industrial use cases. This includes the use of biomechnical and kinematic digital human models (ema Work Designer and Anybody Modelling System), as well as a markeless motion capturing system (The Captury). Results from laboratory studies and field pilots will be presented.

Ministry of Education and Research. Purpose of the project is to

### Room 15, Hall 1, 1st Floor Session B2 - Exoskeletons & Exosuits Exhibitors I



04.30 pm - 04.45 pm



be built into the exosuits.

Photo: Dominik

Heinzelmann

Dominik Heinzelmann, hTRIUS GmbH

Co-Speaker: Jonas Haag,

hTRIUS GmbH Abstract: To be able to support the workers and reduce injury risk, exoskeletons have to meet the requirements

Flexibility in movement, support settings and body size need to

regarding usability in the everyday work of the end users.

Prevention of finger injuries: challenges, approaches and a fitting solution



project team.

04.45 pm - 05.00 pm

Miguel Bravo,

Digity GmbH

Abstract: Exoskeletons used at the workplace for prevention of injuries receive great attention

for many body segments. However, passive finger exoskeletons are not widely nor optimally addressed, in spite of the relevant role of our hands in most tasks. In this presentation we will share our research experience identifying the technical aspects that make these devices such a challenge, we will explore the current solutions, and we will present our developed technology that makes the next generation of finger exoskeletons for prevention of finger injuries a reality.

#### Revolutionary way of changing standing work 05.00 pm - 05.15 pm



Katsuhiko Saho, Archelis Inc.

**Abstract**:

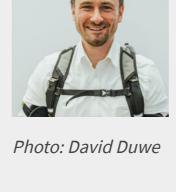
I will introduce our novel exoskeleton suit

"archelisFX Stick". "Archelis FX Stick" is an ultra-lightweight exoskeleton assist suit that safeguards workers against lower-back pains and other physical strains from long

hours of standing.

#### practice sharing 05.15 pm - 05.30 pm

20,000+ exoskeletons in the field. Lessons learned and best



David Duwe, Ottobock Bionic Exoskeletons

Abstract: More and more companies use exoskeletons to keep their employees fit and healthy or to attract new ones?

How do successful implementations look like? What should I know before jumping into this topic? Let's find out together based on 10+ year experience in the field of exoskeletons. Activity-adapted support through active exoskeletons

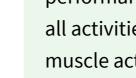
# 05.30 pm - 05.45 pm



Dr. Andreas Argubi-Wollesen, exoIQ GmbH

Exoskeletons lower the required muscle activity for a wide range of work activities via their support

performance. However, they do not do this to the same extent for all activities. In certain cases, they can even increase the required muscle activity, especially when users find themselves having to actually work against the support force. Using the example of the active exoskeleton \$700, we would like to demonstrate how these unwanted effects can be minimized to the greatest possible extent by means of pre-sets adapted to the activities, thus significantly increasing the user acceptance of exoskeletons.



Abstract:

Q&A 5.45 pm – 6.00 pm