Exoskeletons in the Workplace – Assessing Safety, Usability, & Productivity
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Chair
Christopher R. Reid, The Boeing Company

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David Rempel, University of California, Berkeley/University of California, San Francisco
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PROGRAM

7:00–8:00 a.m.
Continental breakfast and networking
Sponsored by Levitate Technologies, Inc.
Room: Franklin 11 (Level 4)

8:00–9:00 a.m.
Welcome
Christopher R. Reid, The Boeing Company
George Brogmus, Liberty Mutual Insurance

Opening Keynote Address – Wearable Robotic Systems: Global Landscape and Opportunities
Presented by Bruce Floersheim, WearRAcon / GoXStudio
Wearable robotic systems are quickly changing the realm of possibility with regard to optimizing human performance and improving physical rehabilitation. Floersheim will present an overview of the ecosystem of wearable robotics, provide a picture of global development and growth, and look at possibilities and issues of concern that will impact the future of the ergonomics and human factors in the next decade.

Standards Update: ASTM F48, ISO, ...
Presented by William Billotte, NIST/ASTM

9:00–9:30 a.m.
Networking refreshment break
Sponsored by ASTM INTERNATIONAL

9:30–11:15 a.m.
Exoskeleton User Discussion Panel
Who are the faces and advocates behind the users of exoskeletons and exosuits? What questions and concerns should exoskeleton and exosuit developers be mindful of when designing products for their customers? This user discussion panel session features a deep dive into the concerns from the perspective of experts in industrial, military, and medical domains who help to advocate for the safety and performance of exoskeleton and exosuit users.

Moderated by Robert R. (Bob) Fox, General Motors
• Introducing Exoskeletons Into the Toyota Manufacturing Environment, Robbie Schram, Toyota
• U.S. Navy Human Assistive Technology, Ron Zmijewski, U.S. Navy
• Exoskeletons as Assistive Technology for Rehabilitation: Clinical Perspectives, Kendra Betz, U.S. Veterans Affairs
Research Methods 1 – Design for Population Accommodation & Performance

It is important to understand the extent to which a targeted user population will be able to be properly sized and fitted to an exoskeleton and exosuit system. Additionally, it is necessary to understand whether varying aspects of a user population’s age, gender, injury history, cognition, strength, and/or range of motion are applicable to system usage, which could have a positive or negative influence for safety and performance. This discussion panel will allow for audience discussion with researchers who are looking for lessons learned regarding nuances of the human population of exoskeleton/exosuit end users.

Moderated by Krystyna Gielo-Perczak, University of Connecticut

- Three-Dimensional Anthropometric Data for Exoskeleton and Exosuit Design, Monica Jones, University of Michigan
- Anthropometric Considerations in Exoskeleton Development, Joseph Parham, U.S. Army Natick Soldier Research Development & Engineering Center (NSRDEC)
- Quantifying Physical and Cognitive Fit for Assessing Exoskeletons, Leia Stirling, MIT

11:15 a.m.–12:00 p.m.

View the Exhibits:

Ekso Bionics, Booth E2
General Motors, Booth E6
GoX Studio, Booth E5
Levitate Technologies, Inc., Booth E1
Mawashi Science & Technology, Booth E3
Sarcos Robotics, Booth E7
suitX, Booth E4

12:00–1:00 p.m.

Networking Lunch
Sponsored by The Boeing Company
Room: Franklin 11 (Level 4)

1:00–3:15 p.m.

Afternoon Keynote Address – Ergonomic Assessment of a Space Suit: From the Perspective of Population Analysis, Fit, Accommodation, Comfort, and Performance

Presented by Sudhakar Rajulu, NASA Johnson Space Center

Early ergonomic evaluation of an exoskeleton is necessary to ensure a successful, safe, and comfortable deployment into a workplace with a wide range of users. Rajulu will present a population-based approach undertaken by the Anthropometry and Biomechanics Facility at NASA to assess and improve the design of a pressurized space suit being worn by astronauts for microgravity and partial-gravity environments. He will present the essential steps that are needed to evaluate prototypes of a complex ensemble such as an industrial exoskeleton for a large user population with potentially limited test subject data.

Exoskeleton Developer Discussion Panel

Exo Squad, Elysium, Edge of Tomorrow, Aliens, and Iron Man. What visions of grandeur are conjured when we think of what Hollywood has imagined our future to be? But how much of science fiction can become science fact? And how will we do that safely, reliably, and effectively for the people who intend to use these exoskeletons and exosuits? This developer discussion panel will allow us to tap into the visions that current manufacturers are pursuing and enable audience members and developers an opportunity to discuss processes, technology, or needed human research.

Moderated by Christopher R. Reid, The Boeing Company

- Achieving Technical and Manufacturing Readiness for the Commercialization of Powered Exoskeletons, Chris Beaufait, Sarcos Robotics
- Roboglove – A Human Grasp-Assist Device, Marty Linn, General Motors
- Lightweight and Nonrestrictive Soft Exosuits for Improving Human Performance and Preventing Injuries, Ignacio Galiana, Harvard Wyss Institute
- Exoskeletons – Ideas for Implementation and Change Management, Brandon Frees, Ekso Bionics

Research Methods 2 – Assessing System Usability

It is important to understand how a person would interface and integrate, both physically and cognitively, with an exoskeleton and exosuit system. Ideal system usability and user experience can lead to improved outcomes such as performance gains or, conversely, lead to impaired safety, discomfort, or confusion in utilization. This interactive discussion panel with researchers who have been looking into how these devices interact with people and the positive and/or negative outcomes that are starting to be seen from exoskeleton/exosuit use.

Moderated by Carisa Harris-Adamson, University of California at San Francisco/University of California at Berkeley
• Exoskeleton Usability: Task Differences and Anthropomorphism, Kevin Purcell, U.S. Army Public Health Center
• Perspectives on Exoskeleton Usability: Insight from Boeing Factory Introduction, Kadon Kyte, The Boeing Company
• Assessing System Usability: Research Methods and Special Considerations for Rehabilitative Exoskeleton Evaluation, Alix Dorfman, Underwriters Lab (UL), Wiklund

3:15–3:30 p.m.

Networking refreshment break
Sponsored by Liberty Mutual Insurance and Northern Illinois University – College of Engineering & Engineering Technology

3:30–6:00 p.m.

Research Methods 3 – Assessing Safety
What are the implications of wearing and using exoskeletons and exosuits? This interactive session will engage audience members in a discussion with panelists that examines the physical, physiological, hygienic, biomechanical, and/or usage effects with respect to safety concerns.
Moderated by Brian Lowe, National Institute for Occupational Safety and Health
• Assuring the Safety of Medical Exoskeletons: An FDA Reviewer Perspective, Ian Marcus, FDA
• Toward Standard Test Methods for Exoskeletons, Roger Bostelman, NIST
• Assessing Safety of Physical Augmentation Technologies for the Dismounted Soldier, Angela Boynton, U.S. Army Research Laboratory

Research Methods 4 – Assessing Ergonomics
It is important to understand any cumulative or longitudinal implications of wearing and using exoskeletons and exosuits. This task requires the examination of the physiological and biomechanical effects to estimate potential concerns that could occur over time. Subject matter experts on this panel, along with audience members, will discuss exoskeleton/exosuit human research looking into ergonomics areas such as musculoskeletal or physiological concerns and/or performance gains.
Moderated by Cathy White, Dow Chemical Company
• Perspectives on Implementing an Exoskeleton Program in Automotive Manufacturing, Marty Smets, Ford Motor Company
• Lab-Based Assessments of Occupational Exoskeletons: Overview of Methods and Results, Maury Nussbaum, Virginia Tech
• Exoskeleton Technology for Gait Rehabilitation: Combining Clinical Application and Research Methods, Karen Nolan, Kessler Foundation

Closing Discussion Panel
Conferences and symposia typically close with a summary of the activities and findings presented by the event chairs. This time we are doing things a bit differently: We are inviting summaries from the perspectives of exoskeleton and exosuit subject matter experts themselves, each of whom brings a different application, industry, or expert perspective. This closing discussion panel will allow for audience interaction with experts on workers compensation, representatives from the U.S. Department of Defense, medical exoskeleton device researchers, and industry standards experts to help shape near-term and long-term next steps in exoskeleton and exosuit development.
Moderated by Cindy Whitehead, U.S. Navy – Naval Sea System Command
• DoD Views on Exoskeleton Development and Use, Ben Petro, U.S. Office of the Secretary of Defense (Presented by Cindy Whitehead)
• Some Thoughts on Industrial Exoskeletons from a Worker Compensation Perspective, Delia Treaster, Ohio Bureau of Workers Compensation
• Rehabilitation Application of Wearable Exoskeletons, Gerard Francisco, TIRR Memorial Hermann Hospital
• Exosystems Testing, Validation, and Standardization, Donald Peterson, Northern Illinois University / ASTM F48

Adjournment
Christopher R. Reid, The Boeing Company

6:30–9:30 p.m.

HFES Annual Meeting Opening Reception
Room: Salon E (Level 5)
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- Patient Safety Research and Initiatives

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