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Fall Fashion:
Wearable Robotics in the DC

Track 5 Session 8



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Abstract

The irreplaceable human element of the supply chain has its limits and variabilities. The science of wearable robotics aims to extend those limits for the betterment of the human and workplace. This fascinating show-and-tell will expose a future where exoskeletons and exosuits promise to reduce fatigue, overcome disabilities, enhance strength, and enable the productivity of Tony Stark... only for good, not evil.

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Agenda

- **Overview of Wearable Robotics for Industrial Applications**
- **Demonstration**
- **Key Takeaways**
- **Conference Cloud**
- **Questions**

What is Fueling the Growth of Wearable Robotic Systems?

- **Global Demographics**
 - Older workforce
- **Better robotic systems**
 - Batteries, sensors, actuators, microprocessors



Cyberdyne

What is a Wearable Robotic System?

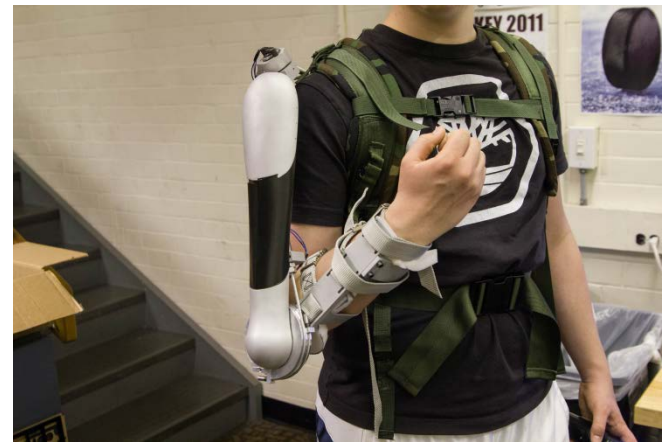
- **Device worn on the body to assist the user**
 - Anthropomorphic or Non-anthropomorphic
- **Device can be Passive or Active**
 - Passive systems use springs or structures to push or pull on the body
 - Active systems use motor/pneumatics/hydraulics to assist the user in the task. “Put energy into the system”
- **Device can assist a joint or transfer the load to the ground**

What is a Wearable Robotic System?

- **Device can be soft or have a structure**
 - Soft systems that conform to the body are more comfortable but rely on the human joints to absorb the reaction loads
 - Systems with structures have mechanical joints to absorb the reaction loads



Harvard



Penn

Goals of a Wearable Robotic System

- **Seamlessly interact with the user**
- **Must not disrupt the natural gait cycle**
- **Pay for the weight penalty (must reduce metabolic cost)**
- **Easy to use, must not have to think about it**
- **Lastly, walk faster, jump higher, run faster, lift heavy objects**



Challenges

- **Most bionic devices are too heavy**
 - Increased metabolic cost
 - Large and clunky
- **Most bionic devices do not seamlessly interact with the user**
 - Impair gait motion
 - Must use tricks or patterns to get them to work
 - Not intuitive
 - Use standard controllers from the robot community

Overcome the Challenges

- **Store and release energy using springs, pneumatics, etc.**
- **Use human based controllers**
 - Add positive power to the gait cycle
 - Respond to the user's movement
- **Motors, batteries, and microprocessors are cheaper, faster and lighter**

Hip Exoskeleton



Device must be:

- Portable
- Lightweight
- Pay for the weight penalty of the device
- Safe

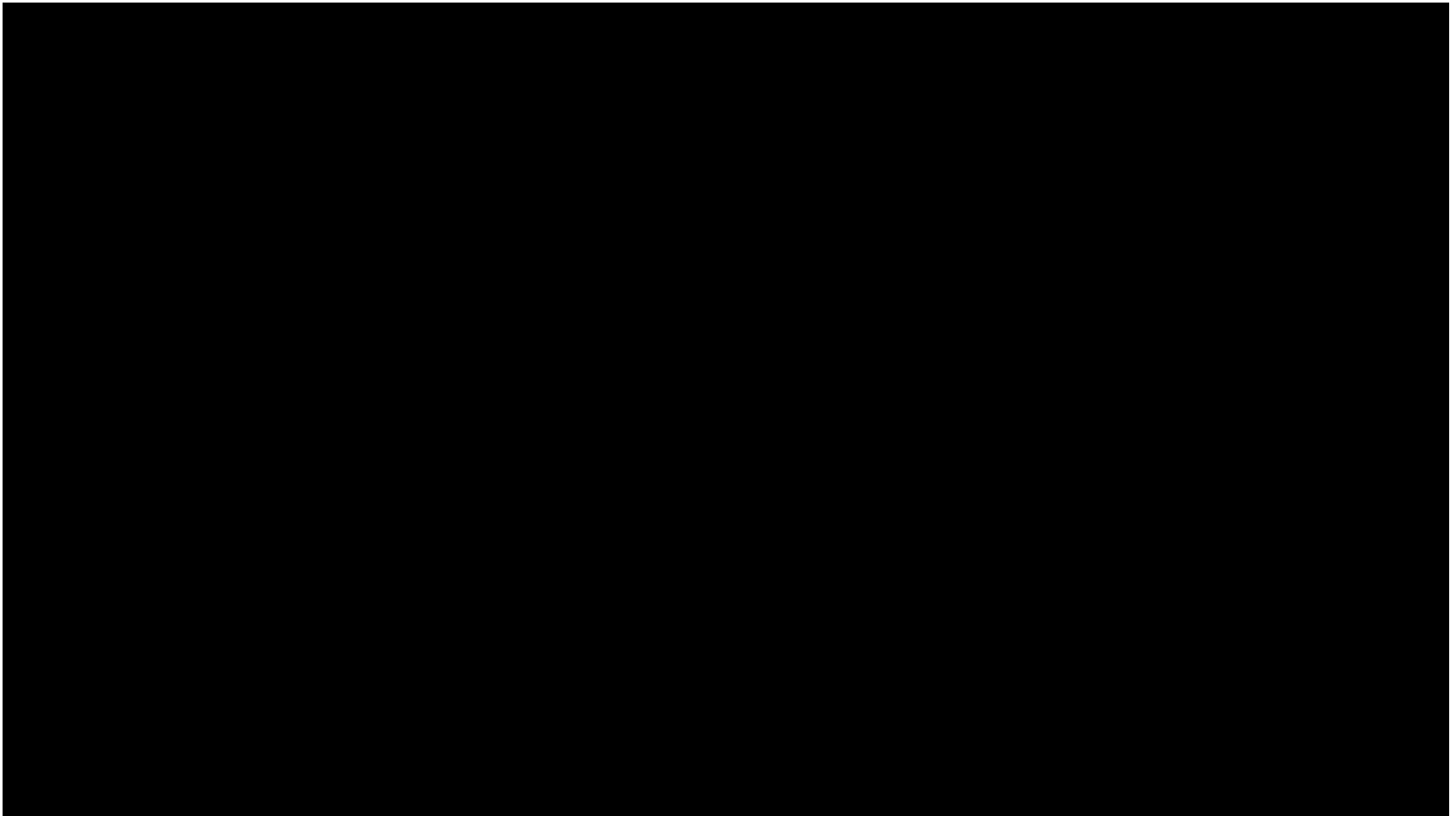
Systems combine soft straps with a motorized joint



SpringActive Torque Assist Hip Exoskeleton



Hip Exoskeleton



Overview of Industrial Exoskeletons



Manufacturing and Construction



Daewoo, Korea



RB3D, France



Fortis, USA



BAE Systems, England



MAX Exoskeleton, US Bionics

Overview of Industrial Exoskeletons



Manufacturing and Construction



Cyberdyne, Lumbar System



Robomate, Germany



Panasonic, Japan

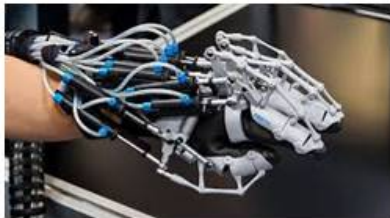


Arm Exoskeleton,
Stuttgart, Germany

Overview of Industrial Exoskeletons



Manufacturing and Construction



Festo, Germany



Cybergrasp, USA



Roboglove, Bioservo, USA

Overview of Industrial Exoskeletons



Manufacturing and Construction



Strong Arm, USA



Noonee, Switzerland



X-Ar Equipois Inc. (USA)



Laevo, NL



Demonstration

- **Demonstrate a Hip Exoskeleton**
- **Goal: Walk faster with less fatigue**
 - Follow the human motion
 - Walk forwards and backwards
 - Walk and transition to a jog
 - Can reduce metabolic cost

 - Motors/Batteries – can last 3 hours on a small battery



Key Takeaways

- **Wearable systems can assist the upper body and lower limbs**
- **Systems are being developed that are passive or active**
- **Systems must be comfortable, easy to use, and pay for the weight penalty**

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Conference Cloud

Additional Resources

- **More information can be found at:**
<http://www.wearablerobotics.com>



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Questions?