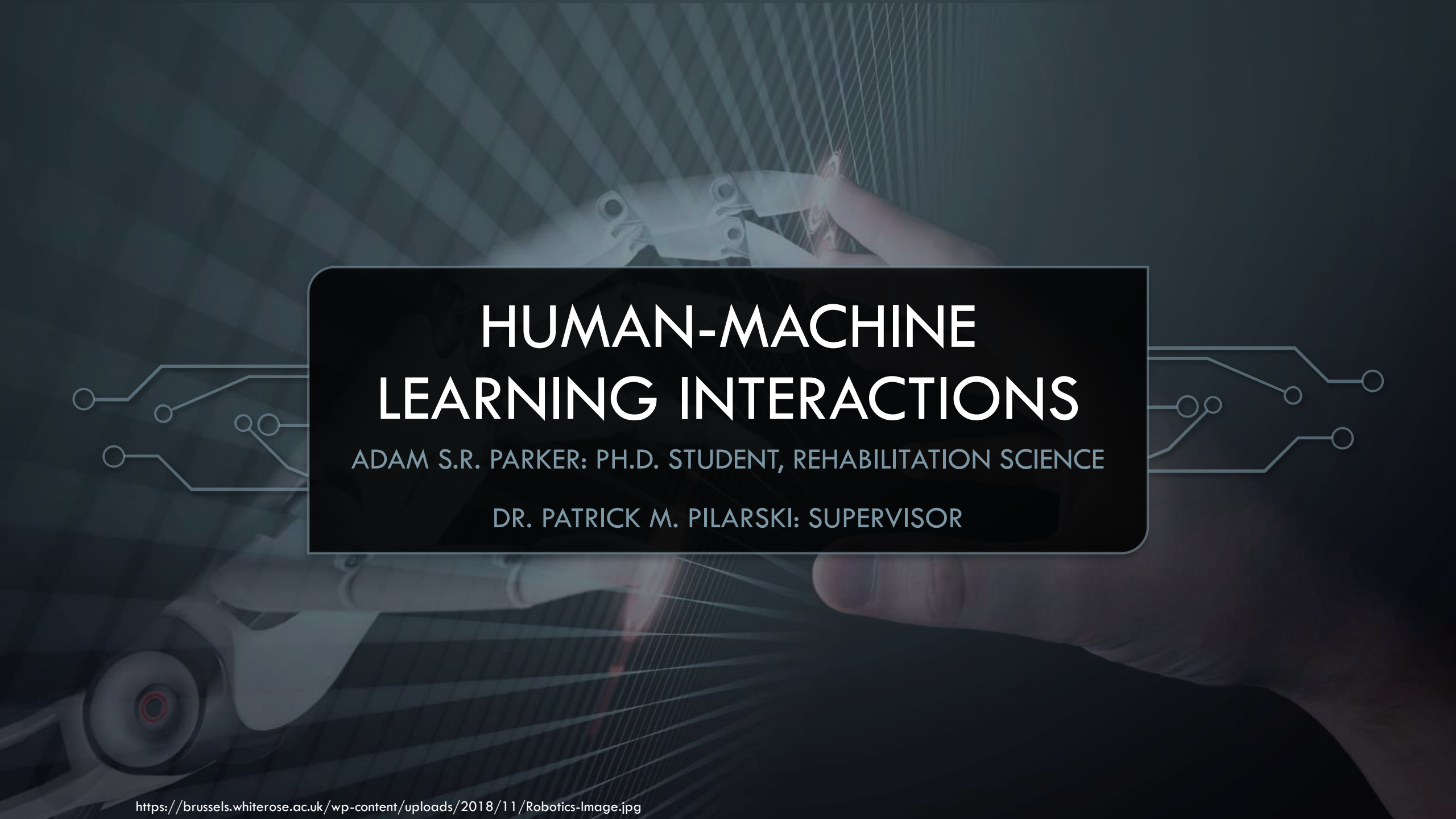

HUMAN-MACHINE LEARNING INTERACTIONS

ADAM S.R. PARKER: PH.D. STUDENT, REHABILITATION SCIENCE

DR. PATRICK M. PILARSKI: SUPERVISOR

https://brussels.whiterose.ac.uk/wp-content/uploads/2018/11/Robotics-Image.jpg

HUMANS AND COMPUTING

- Increasingly, humans are interacting with machine learning
- Increasing need to think about human and machine-learning interactions

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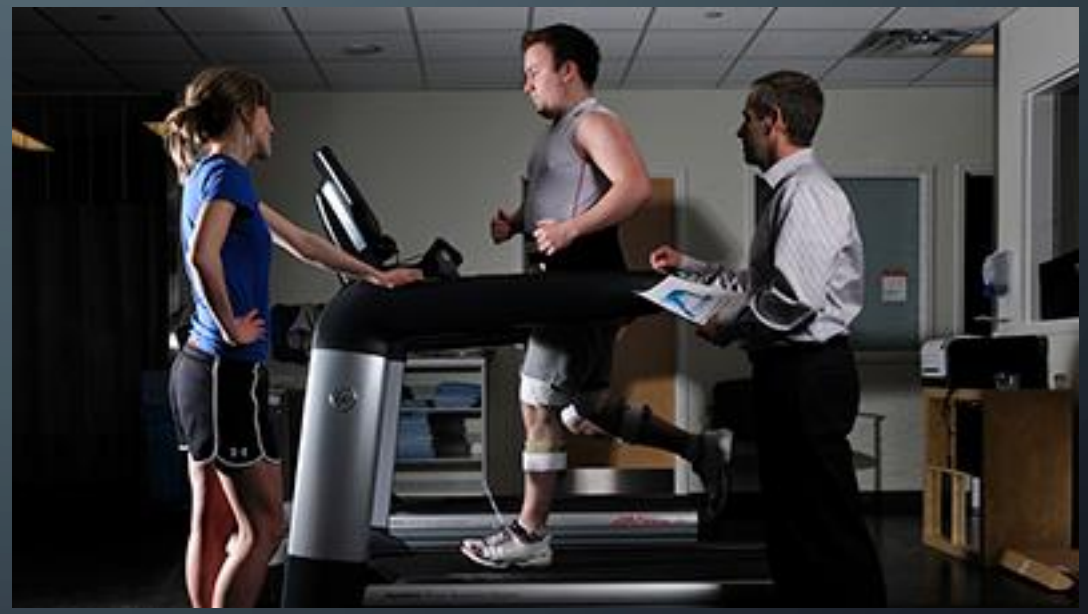
REHABILITATION MEDICINE

- Human-human interaction
- Human-machine interaction
- Person first [1]
  - Language
  - Treatment

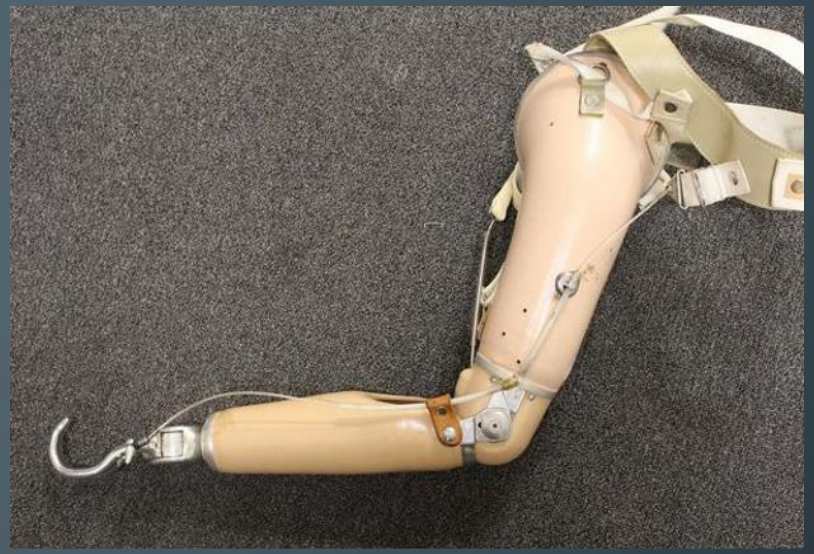


https://cloudfront.ualberta.ca/-/media/rehabilitation/faculty-site/research/research-images/navigation-4.jpg

[1] Darrah, J., Loomis, J., Manns, P., Norton, B., & May, L. (2006). Role of conceptual models in a physical therapy curriculum: Application of an integrated model of theory, research, and clinical practice. *Physiotherapy Theory and Practice*, *22*(5), 239–250. https://doi.org/10.1080/09593980600927765

PROSTHETIC LIMBS

- Artificial limb
- Specific rehabilitation robot
  - intended to live closely with user
- Users of prosthetic arms tend to use physical systems over myoelectric [1]



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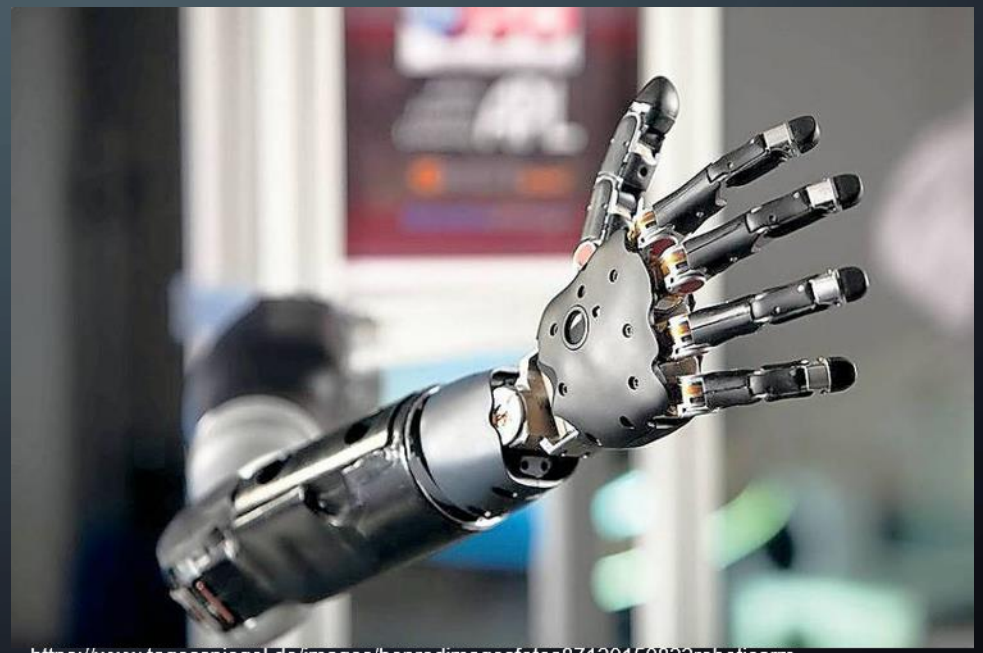

https://www.tagesspiegel.de/images/heprodimagesfotos87120150822roboticarm-jpg/12219146/2-format43.jpg

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MACHINE LEARNING AND PROSTHETICS

- Prediction
  - Dynamic/adaptive switching[1]
- Representation
  - Selective Kanerva coding[2]
- Control
  - Surface EMG classification for hands[3]

[1] Edwards, A. L., Dawson, M. R., Hebert, J. S., Sherstan, C., Sutton, R. S., Chan, K. M., & Pilarski, P. M. (2016). Application of real-time machine learning to myoelectric prosthesis control: A case series in adaptive switching. *Prosthetics and orthotics international*, *40*(5), 573-581.

[2] Travnik, J. B., & Pilarski, P. M. (2017, July). Representing high-dimensional data to intelligent prostheses and other wearable assistive robots: A first comparison of tile coding and selective Kanerva coding. In *2017 International Conference on Rehabilitation Robotics (ICORR)* (pp. 1443-1450). IEEE.

[3] Castellini, C., Gruppioni, E., Davalli, A., & Sandini, G. (2009). Fine detection of grasp force and posture by amputees via surface electromyography. *Journal of Physiology-Paris*, *103*(3-5), 255-262.

https://manofmany.com/wp-content/uploads/2016/07/deusex2.jpg

PERSPECTIVES

- Machine-learning agent can't move robot
  - Has a goal
  - Has a human

PERSPECTIVES

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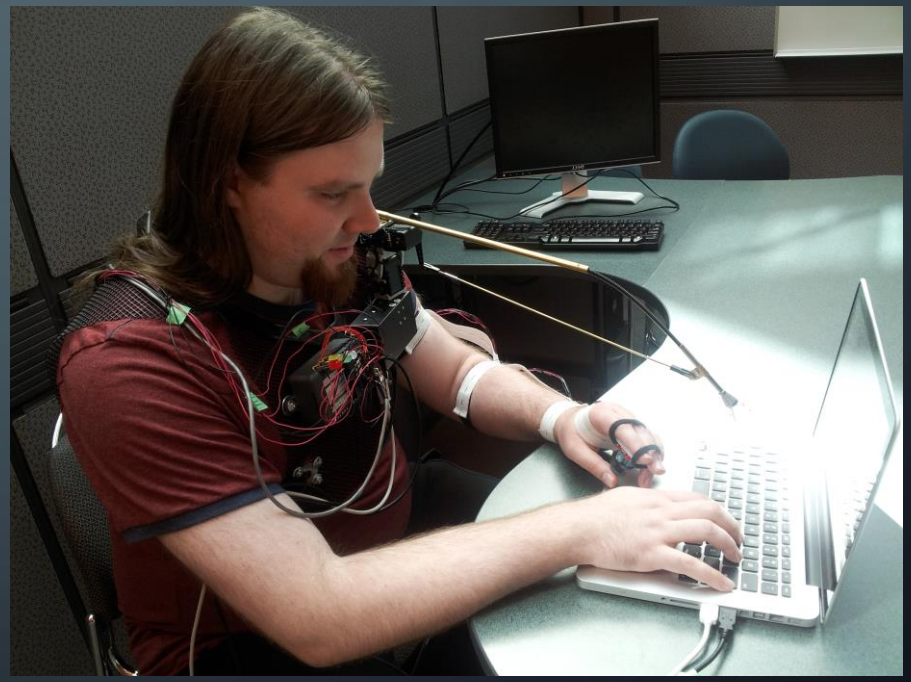
PERSPECTIVES



https://wiki.nps.edu/download/attachments/17799191/iRobot_Create.png?version=1&modificationDate=1318523196000&api=v2

JOINT ACTION AND EMERGENT COMMUNICATION

- Two machine agents develop an arbitrary vocabulary[1]

- Prediction another agent[2]
- Non-verbal communication[3]

https://i.pinimg.com/originals/1b/6e/b2/1b6eb2e475ce39634e43a1f7ac55450e.png

[1] Lazaridou, A., Peysakhovich, A., & Baroni, M. (2016). Multi-agent cooperation and the emergence of (natural) language. *arXiv preprint arXiv:1612.07182*.
[2] Sebanz, N., & Knoblich, G. (2009). Prediction in Joint Action: What, When, and Where. *Topics in Cognitive Science*, *1*(2), 353–367. https://doi.org/10.1111/j.1756-8765.2009.01024.x
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MOVING FORWARD

- Capacity for adaptation of machine learning could be of great value to rehabilitation
- Studying human-ML interactions could provide insight into human-human interaction

https://images.theconversation.com/files/214559/original/file-20180412-549-7ljgm5.jpg?ixlib=rb-1.1.0&q=45&auto=format&w=754&fit=clip

https://ussinnovate.com/wp-content/uploads/2018/07/How-Can-Artificial-Intelligence-Be-Safe-630x330.jpg

CONCLUSION

- The world contains humans
- Communicating is an action
- Collaboration

THANK YOU

QUESTIONS?