

NRI: INT: MiaPURE (Modular, Interactive and Adaptive Personalized Unique Rolling Experience)

PI: Elizabeth Hsiao-Wecksler^a, Co-PIs: Deana McDonagh^b, William (Bob) Norris^c, Sr. Personnel: João Ramos^a, Adam Bleakney^d, Jeannette Elliot^d, Patricia Malik^d, Grad Stud: Chenzhang Xiao^a, Seung Yun (Leo) Song^a, Yu Chen^a, Mahshid Mansouri^a, Nadja Marina^a
 University of Illinois at Urbana-Champaign: ^a Mech Sci & Eng, ^b Art+Design (Ind Design), ^c Ind & Sys Eng, ^d Disability Res & Educ Serv

Challenge:

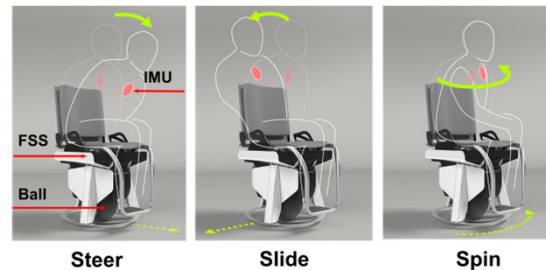
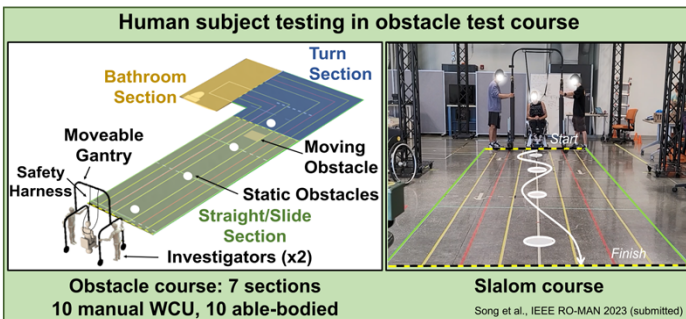
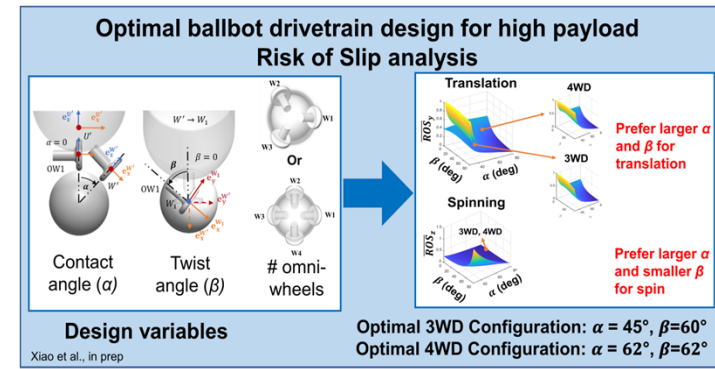
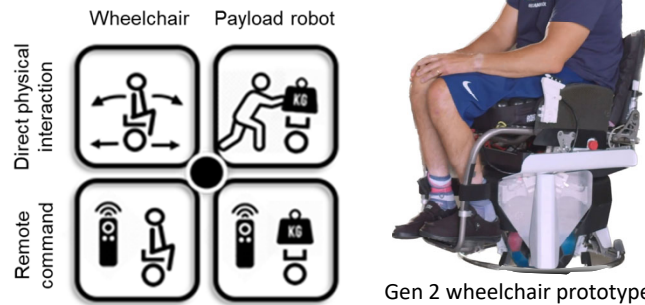
- Design & control ballbots for top-heavy payloads
- Exploit modularity btw wheelchair and companion robot
- Create disruptive approach for wheeled mobility

Solution: PURE (Personalized Unique Rolling Experience)

- **M**odular, **i**nteractive, **a**daptive design
- Common drivetrain: optimize for high payload
- Torso-dynamics Estimation System (TES)
 - Force sensing seat (FSS) + IMU
- Shared motion control for driver assistance with obstacle detection & collision avoidance
- User-centered design: wheelchair users as researchers, user experience group, test participants

Scientific Impact:

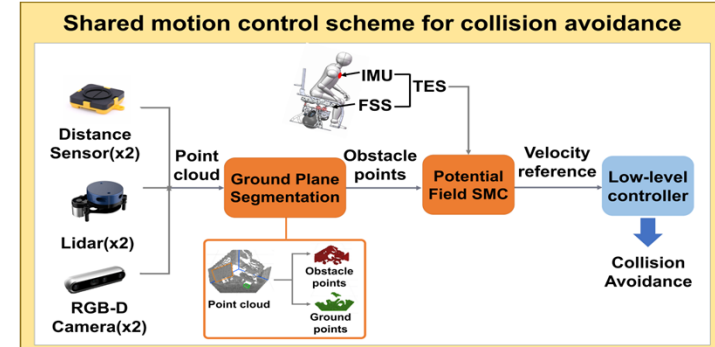
- Universal mobility platform with high payload capacity, agile omni-directional movements, and minimal footprint
- Intuitive operation (torso estimation system for hands-free control)



Future Targets:

Max capacity: 114 kg
 Max speed: 2.7 m/s

Modular interchangeable quick-connect human-robot interfaces



Broader Impacts:

- Fundamental wheelchair design same since 1800's
- 65M wheelchair users (WCU) worldwide. Overuse injuries in >70% manual WCUs
- Design thinking focused specifically on design for disability
- E&O: Beckman Institute Open House 2023 (35K visitors)

