Workshop on Humanoid Teleoperation



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Why humanoid robot teleoperation



To care for people at home





Which interface for teleoperating?



Telepresence now

Telepresence future





Teleoperation basic: the robots



Teleoperation: some examples

TELESAR II (telexistence system, TachiLab, Tokyo)





SUPVIS-JUSTIN with haptic feedback (DLR)



, iCub with VR omniwalk (IIT)

JAXON2 (Inaba, Tokyo)

Teleoperation in space



Teleoperation

• Objective: develop principles to allow for natural and effective teleoperation of the robot by human(s)



Attributes affect the interaction between human and robots.

- Level and behavior of autonomy
- Nature of information exchange
- Structure of the team
- Adaptation, learning, and training of people and the robot
- Shape of the task



Common metrics

Devote more attention to the core questions of the field:

- Allows the share of knowledge and compare findings
- Analyze in three aspects: human, robot and system
- Identify and discuss metrics throughout the application space



Workshop Organization

Some questions we will try to address today

- What are the factors which determine the proper **autonomy** level of the robot for teleoperation scenarios?
- Does robot need to **predict the human motions** and intentions during teleoperation scenarios?
- How we can provide a **balance between the robot dexterity**, **manoeuvrability**, **and robot stability** while it follows the human commands?
- How we can **map** the human motions to the robot motions in situations which the human and robot dynamics are largely different, e.g., space exploration scenarios?
- How we can design **intuitive interfaces** for human, to increase the performance and effectiveness while providing an immersive teleoperation experience to the human?

Program: morning session 1

Time	Talk
8.45 - 9.00	Welcome & Introduction
9.00 - 9.30	Kourosh Darvish & Serena Ivaldi –
9.30 - 9.50	Yuto Nakanishi (Video) Teleoperation of humanoid robot, space teleoperation challenges and approaches in Gitai
9.50 - 10.10	ANA Avatar XPRIZE The ANA Avatar XPRIZE: Inspiring creators, inventors and futurists to design and construct the future of robotic avatars
10.10 - 10.30	Poster Pitch Presentations
10.30 - 11.00	Coffee break

Program: morning session II

11.00 - 11.30	Enrico Mingo Teleoperation of humanoid robot, in specific WALK-MAN teleoperation challenges, experiences in DARPA robotic challenge
11.30 - 12.00	Yohei Kakiuchi Teleoperation of a humanoid robot with whole-body motion for object manipulation
12.00 - 12.30	Joshua Mehling Challenges and approaches for teleoperation of humanoid robot for space exploration, experiences with Robonaut2
12.30 - 14.00	Lunch Vote this issue to join us for lunch

Program: afternoon session I

14.00 - 14.30	Neal Lii Toward multi-modal space teleoperation: A look back at METERON SUPVIS Justin and what lies ahead
14.30 - 15.00	Joao Ramos Dynamic synchronization of human operator and humanoid robot via bilateral feedback teleoperation
15.00 - 15.30	Jerry Pratt Humanoids avatar for co-exploration of hazardous environments, lessons learned from DARPA Robotics Challenge
15.30 - 16.00	Coffee break

Program: afternoon session II

15.30 - 16.00	Coffee break
16.00 - 16.30	Rafael Cisneros Limon Teleoperated manipulation and locomotion for humanoid robots in partially unknown real environments by using task sequences
16.30 - 17.00	Panel discussion

Join us for the panel discussion!!

Lunch: join us for a quick bite!



Dinner: join us for informal discussion!



- We are recording the workshop presentations!
- Videos will be available on Youtube soon after the workshop
- Check our twitter feeds or the website: <u>https://dic-iit.github.io/WS_teleoepration_humanoids/</u>

Questions for panel discussion

• If you have questions for the panel discussion, notify the organizers during coffee breaks or before the panel





Teleoperation of walking humanoid robot





[1] K. Darvish, Y. Tirupachuri, G. Romualdi, L. Rapetti, D. Ferigo, F. J. A. Chavez, D. Pucci, "Whole-body geometric retargeting for humanoid robots," in Proceedings of 2019 IEEE International Conference on Humanoid Robots (*Humanoids*), Toronto, Canada, October, 2019.
[2] M. Elobaid, Y. Hu, G. Romualdi, S. Dafarra J. Babic, D. Pucci, "Telexistence and teleoperation for walking humanoid robots," in 2019 Proceedings of IntelliSys Conference, London, UK, September 2019. [2]

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Teleoperation of walking humanoid robot







Teleoperation of walking humanoid robot







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Geometric retargeting

Kinematic whole body motion retargeting







Scalability of the geometric retargeting

Synchronization done manually



*The base of the human is not anthropomorphically mapped to the robot models. Hence, the sway of robot models like Nao during dynamic movements





Whole-body balancing retargeting







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Thank you