AmiEs symposium Porto 2026

Stretch robot projects and thesis at TalTech IT College

Assoc. Prof. Dr. Kalle Tammemäe
Tallinn University of Technology (TalTech)
School of IT
IT College

Content

- Research group(s) at TalTech IT College
- Stretch 3 telescopic remote controllable service robot

- Course projects
- Bachelor thesis
  - Operator presence visualization
  - Cleaning the playroom
  - Bird beak gripper in lab environment
- PhD thesis

© Kalle Tammemäe

Research groups at TalTech IT College

- IT Didactics research group „Creativity matters“
  - Launched in 2022
  - Currently:
    - 4 professors (lead by Assistant Prof. Janika Leoste)
    - 3 researchers
    - 5 PhD students
    - Research projects (Estonian Research Council, Erasmus+, …)
    - EuroTEQ courses
    - The first two PhD defences in 2026, the third one is coming
  - Telepresence robots – Temi, Ohmni, Double, Stretch 3

© Kalle Tammemäe

Stretch 3 robot from Hello Robot

- Strech was developed rather as a mobile manipulator than telepresence robot
  - Open platform, Python, ROS 2, academic community
  - Remote-operation, assistive robot
  - Rather limited autonomy (~2 hours)
  - Universal gripper - can manipulate various objects up to ~2kg
  - Depth and stereo cameras
  - Speakers, directional microphone





© Kalle Tammemäe

Stretch 4 versus Stretch 3



Aaron Edsinger - CEO and Cofounder at Hello Robot Inc.

[Hello Robot Newsletter September 2026]

© Kalle Tammemäe

Course projects 6ECTS, 2025

- Tidying up the playroom (ROS, YOLO model)
- Recognizing and picking up irregular objects
- Bioinspired gripper design (e.g. bird beak, insect mandibles, tongue, tentacles, …)



[Copilot pictures]





© Kalle Tammemäe

Bachelor Thesis 2025: Operator Visibility Addition to the Stretch 3 Robot

- Remote operator identification:
  - Who is there behind the controls?
  - How to visualize when there is no screen?
- Dedicated lights and audio to signal about active remote session (USB Blinkstick)
- Remote Computer IP (in local WiFi network) ➔ screen is required
- Two-directional telecommunication ➔ screen is required







© Kalle Tammemäe

Bachelor thesis 2026: A Special-Purpose Gripper For Robotic Connector Handling

- Required force – up to 19,6N



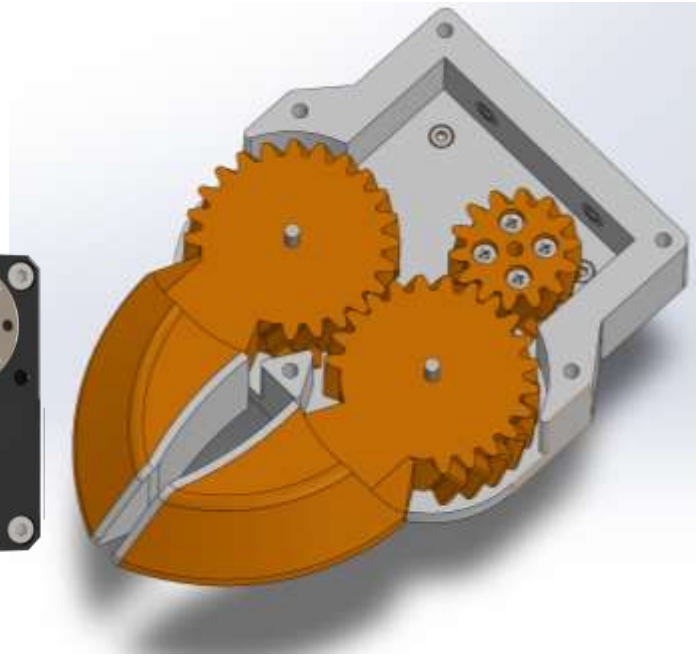






- Dynamixel XM-430-W350-T servomotor
- Feedback: Current, velocity, position
- Herringbone gears
- high-friction material – window seals







© Kalle Tammemäe

Bachelor thesis January 2027: AI guided behaviors on a manipulator robot Stretch 3

- **Goal:** Use Stretch 3 for returning floor-level objects to their saved locations in a small pre-mapped indoor environment
- **Use tools:** ROS 2, FUNMAP (Fast Unified Navigation, Manipulation and Planning), Stretch Deep Perception framework, YOLO 11
- **Study limit:** 3 distinct objects – tennis ball, bottle, cup
- **Result (so far):** 100% success with bottle and ball, 20% with transparent cup



© Kalle Tammemäe

TAL TECH

Author: Kristo Kakkum, supv.: Kalle Tammemäe

PhD thesis (Joosep Parts, ongoing): Securing Remote Interaction with Teleoperable Robots through Privacy-Enhancing Technologies

- **The research addresses** the need for security- and privacy-preserving technologies in robotic systems used in remote education, healthcare, and other public services.
- **The goal is** to design a set of privacy-enhancing technologies using AI/ML tools and techniques which are capable of running as embedded modules on low-resource platforms.
  - The modules will be designed to protect personally identifiable information of individuals within the proximity of a teleoperable robot.
  - The result will be a set of privacy-enhancing real-time prototype modules which will complement an existing teleoperable robot platform enabling safer, more inclusive remote participation.

© Kalle Tammemäe

Series of operator experiments, collecting of behavioral data

- **Study:** Robot-Side Telemetry as a Behavioral Signal for Operator Authentication in Teleoperation
  - Sampling and collecting robot joints, IMU, odometry data, and gamepad channels
  - Can the robot's own telemetry support continuous operator identification and verification?
  - Can the (malicious) impostor be detected?



© Kalle Tammemäe

PhD thesis (Joosep Parts, ongoing): Securing Remote Interaction with Teleoperable Robots through Privacy-Enhancing Technologies

- Research papers
  - **Robot-Side Telemetry as a Behavioral Signal for Operator Authentication in Teleoperation** (on submission)
  - **Trust, Privacy Concern, and Perceived Safety Before and After Physical Interaction with a Mobile Manipulator Robot**, *Future Technologies Conference (FTC)*, 2026 October
  - **A Systematic Scoping Review of Privacy Challenges and Privacy Enhancing Technologies in Teleoperated Robotics**, *IEEE Access*, 2025
  - **Understanding the Potential of Telepresence Robots in Higher Education Learning**, A Case Study, *Future of Information and Communication Conference (FICC)*, 2024

© Kalle Tammemäe

Conclusion

- Every new (robotic) platform extends research and study horizon
- Students are easily attracted to study new platforms, still they are not ready to tackle with multidimensionality (ROS, ML, AI, mechatronics, material science, data analysis, etc.) of problems
  ➔➔ multidisciplinary teams
- Financial issues (ROI - platforms age, components e.g. batteries, moving elements, etc. degrade, the new models vastly outperform the old ones, making the latter of little interest, etc.)
  ➔➔ cooperation

© Kalle Tammemäe

© Kalle Tammemäe

Thanks!

kalle.tammemae@taltech.ee