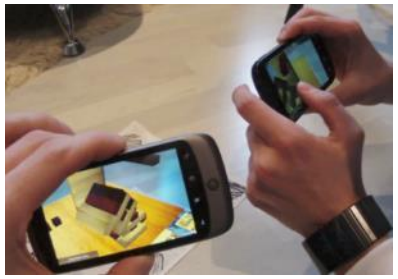
Vorbesprechung Praktika & Projekte

Hugo Brument

SS25

E193-03 Virtual & Augmented Reality Research Group
Institute of Visual Computing & Human-Centered Technology
TU Wien, Austria



VIRTUAL & AUGMENTED REALITY

Hannes Kaufmann

Head of Research Unit, Full Professor

Horst Eidenberger

Associate Professor

Postdocs: Peter Kán, Hugo Brument, Francesco De Pace, Diana Marin

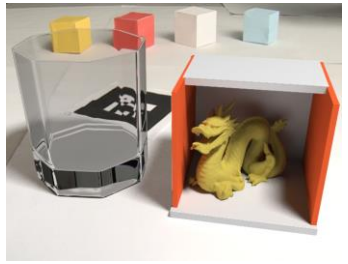
PhDs: Emanuel Vonach, Khrystyna Vasylevska, Soroosh Mortezapoor, Matteo Bosco, Mohammad Ghazanfari + 3 external PhDs

Msc students: 10 students

Virtual & Augmented Reality Themenbereiche

Total: 138,9 FPS

Real Time Ray Tracing in VR



High Quality Rendering in AR

Rendering & Viewing

Localization (Tracking)

Interaction

Distribution

Collaboration

Authoring

Perception

Input

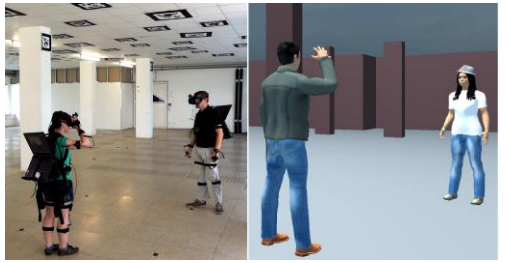
Output

Wide Area Multi-User Optical Localization

ioTracker

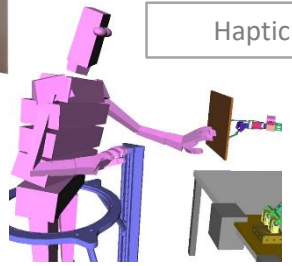
Live 3D Reconstruction for First Responders

Shared Collaborative Virtual Spaces Navigation

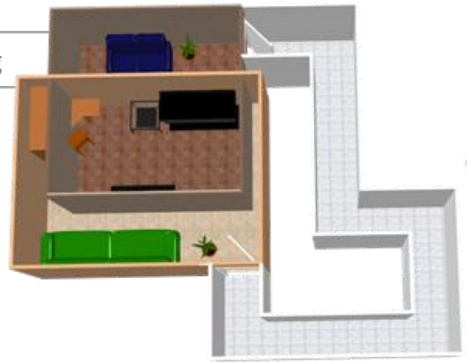


Firefighter Training with Virtualizer

Haptic Feedback

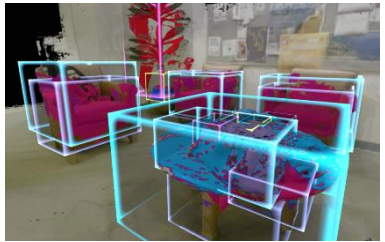


Redirected Walking



Automated 3D Model Generation

Object Detection and Segmentation in Live 3D Reconstruction



unity

UNREAL ENGINE

Courses

- Summer Semester 2025
  - 193.021 Project Media and Human-Centered Computing 1
  - 193.022 Project Media and Human-Centered Computing 2
  - 193.023 Project in Visual Computing 1
  - 193.024 Project in Visual Computing 2
  - 193.117 Project in Computer Science 1
  - 193.118 Project in Computer Science 2

  - Bachelorarbeit für Informatik und Wirtschaftsinformatik; 10 ECTS
  - Master Thesis, 30ECTS

Project Courses: General Info

- **Supervision:** regular meetings with supervisor (e.g., bi-weekly)
- **Hardware:** Suitable lab equipment is provided
- **Process:** literature research, iterative design and development of solution, evaluation and presentation
- **Strong practical component:** independently implement a prototype (hardware and/or software)
- Option to work in a small group (2 people)
- All topics available at
  - https://www.vr.tuwien.ac.at/topics/
  - http://www.vreeclimber.at/student_projects/
  - TISS course pages
  - Slides available on our website in the topic section

Next Steps…

Send us an email with the following information:

- Which course you require credits for
- The idea/topic you wish to pursue
- Your name and Matrikelnummer

To: *<topic supervisor>*

CC: *hannes.kaufmann@tuwien.ac.at*

We will make individual agreements about

- supervision
- hardware pickup
- specific tasks

AUGMENTED REALITY

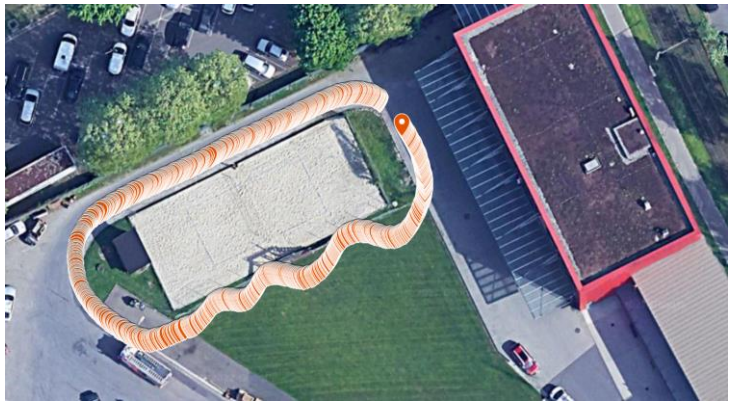
Virtual and Augmented Reality Group

Outdoor Augmented Reality (AR) Tracking System

- AR tracking solutions are not usually suitable for large outdoor areas

- **Task**: development of an outdoor GPS-based tracking system for wearable AR devices (e.g., Magic Leap, Microsoft HoloLens)
  - Verify accuracy of a GPS system (REDCatch):
    - Comparison with the wearable AR device tracking system
  - How to use GPS positional data to improve tracking
  - User tests to assess the effectiveness of proposed solution from a human-centered perspective

- **Setup/IDE:**
  - Many possible solutions (to be discussed)
    - Windows (Unity3D)
    - Android (for GPS)
    - C#, Java/Android, C++
    - ROS

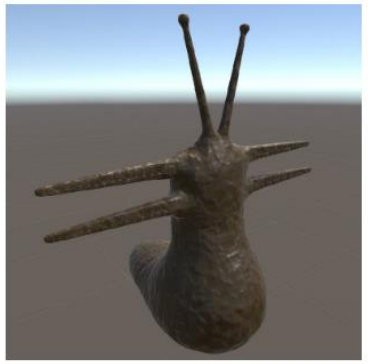


- **Scope**: Master Thesis

- **Supervisor:** francesco.pace@tuwien.ac.at

VIRTUAL REALITY

Co-Embodiment: Design of Locomotion Techniques for a Non-Human Avatar



- Suitable for: BA, PR, Master Thesis

- Goal: Design and implement locomotion metaphors for navigating with a co embodied avatar shared by two users

- Tasks
  - Design a physical and a virtual locomotion technique for navigating with the non human avatar
  - Integrate the techniques to make them work with the non human avatar (including networking)
  - Run an experiment to evaluate the locomotion techniques

- Environment, hardware etc.: Unity3D, Oculus Quest or HTC Vive, potentially hand tracking and inverse kinematics

- Contact: Hugo Brument hugo.brument@tuwien.ac.at

Prediction Of Human Behavior In VR

We often need to know in advance what to expect from a VR user
Task: Continue development of a toolset for action prediction
Your options:

- Implement a predictor for user's action with existing:
  - eye tracking features
  - saliency score
- Optimize locomotion prediction
- Develop a merge between different predictors
- Etc.

- Setup: Standard VR setup with large area tracking
- C#, maybe Python or R -> in Unity
- **Prerequisites:** Programming skills, understanding of predictive systems
- **Scope**: PR, Bc. /Ms. thesis

- **Supervisor:** khrystyna.vasylevska@tuwien.ac.at

Virtual and Augmented Reality Group

Curved Flexible Spaces

Description

Walking in VR poses a number of challenges with fitting a large virtual space within the real workspace. Flexible Spaces solves this by a procedural generation approach that results in a continuously changing self-reorganizing maze. Extend the right-angled geometry of the Flexible Spaces algorithm with curved rooms and corridors.

This is a master-level topic.

Prerequisites

Programming skills, experimental mindset.

Environments

Unreal, C++

Supervisor

Khrystyna Vasylevska khrystyna.vasylevska@tuwien.ac.at

Some inspiration

1. Flexible spaces: Dynamic layout generation for infinite walking in virtual environments
2. Towards efficient spatial compression in self-overlapping virtual environments

XR Accessibility

Description

XR is primarily made for healthy adults. However, there are groups of people that also would like to experience XR, but have little or no possibility to do that.

As the XR spectrum is broad, the primary focus will be on VR, however, exploration of AR accessibility is also possible.

This is a topic for several people.

Task

Depending on the complexity of the project, it might include the following tasks:

- Collect the best practices in Accessibility, analyze how suitable are they for XR, and what adaptation steps they might need
- Develop a package for the game engine to improve Accessibility in one or more aspects
- (optional) Assist with the evaluation and publishing of the results

Prerequisites

Programming skills and exploratory mindset

Possible Environments

Unity or Unreal, consequently C# or C++

Supervisor

Khrystyna Vasylevska khrystyna.vasylevska@tuwien.ac.at

ROBOTICS

Human-robot interaction for AI-assisted collaborative visual arts creation

Supervisor: Peter Kán

11.01.2024

Novel generative algorithms based on AI achieve superior results in text-based image generation or image-to-image translation. Additionally, human-robot collaboration is often required to solve various problems in numerous domains. The main goal of this thesis is to enable collaboration of human and robot for the purpose of visual arts creation (e.g. drawing, painting, or sculpting). Such a collaborative setup can result in novel tangible artistic results. This way, the creativity of humans and generative power of artificial intelligence can be combined to discover novel creations in visual arts. The vision of artificial intelligence will be enabled by a color camera. The acquired images will be processed by neural networks and by generative algorithms based on stable diffusion. Optionally, text-based input can also be provided during the collaboration. The output image from AI generation will be further processed to identify the series of strokes for robot arm that will then execute these strokes. Optionally, the ceiling-mounted projector may be used to indicate future intentions of AI before drawing. The human-robot collaboration can be achieved in an alternated fashion to ensure high safety of the setup. The implementation of robot manipulation will be done using Robot Operating System (ROS) and the AI algorithms will be implemented in python. The developed methods will be evaluated qualitatively in an expert study.

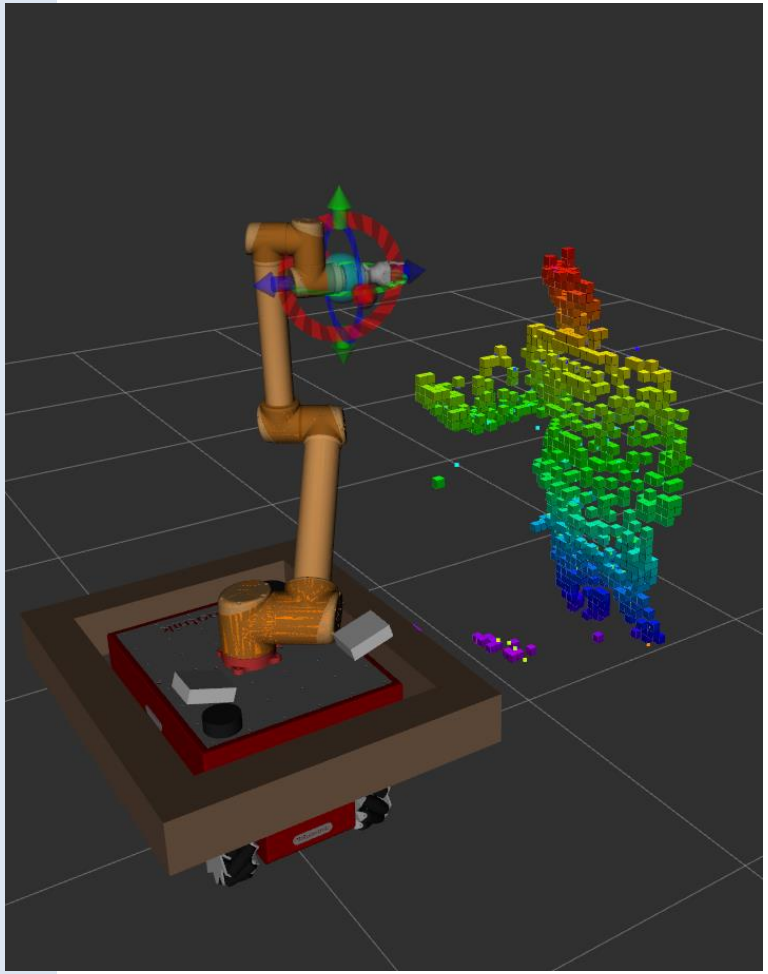
Type: Master thesis

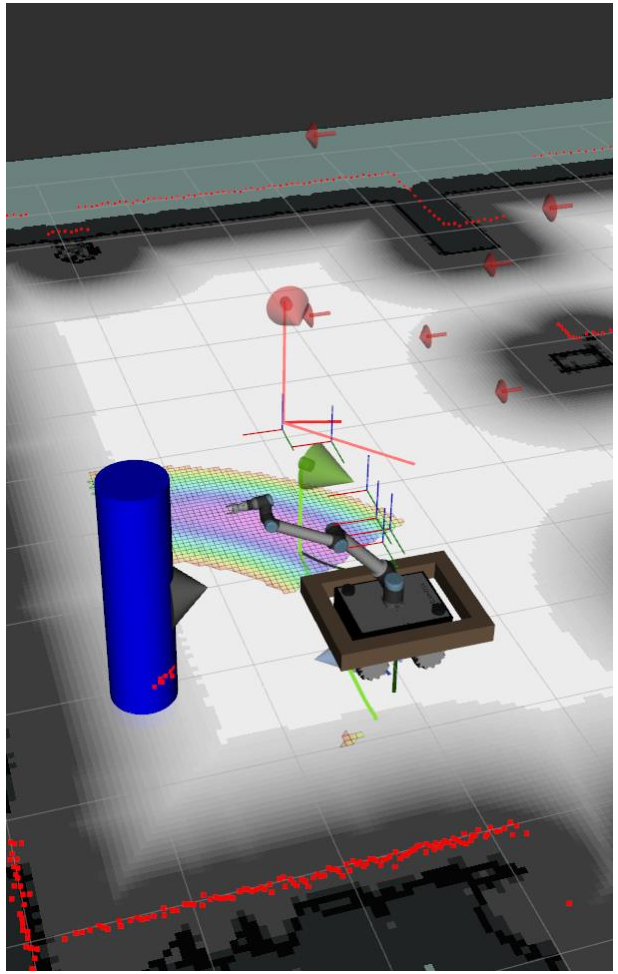
For more information please contact Peter Kán

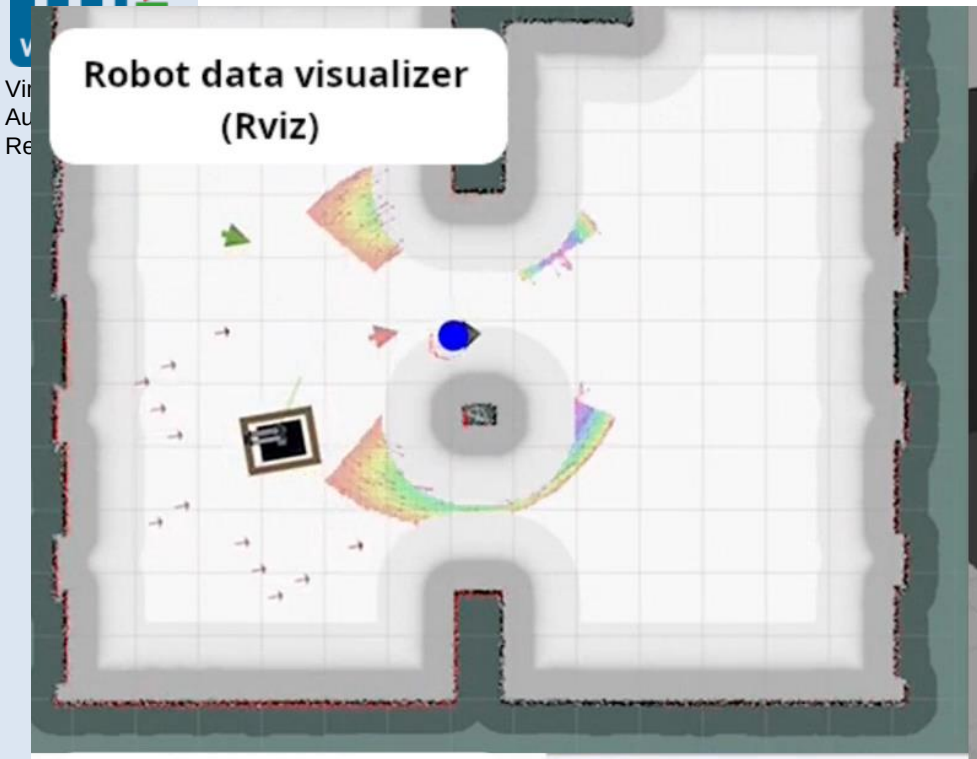
Virtual and Augmented Reality Group

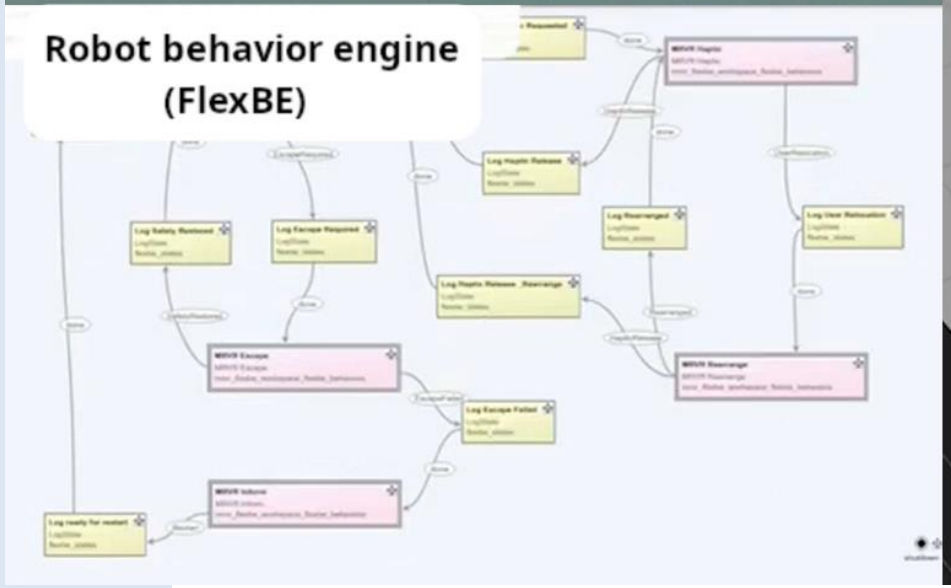
CoboDeck

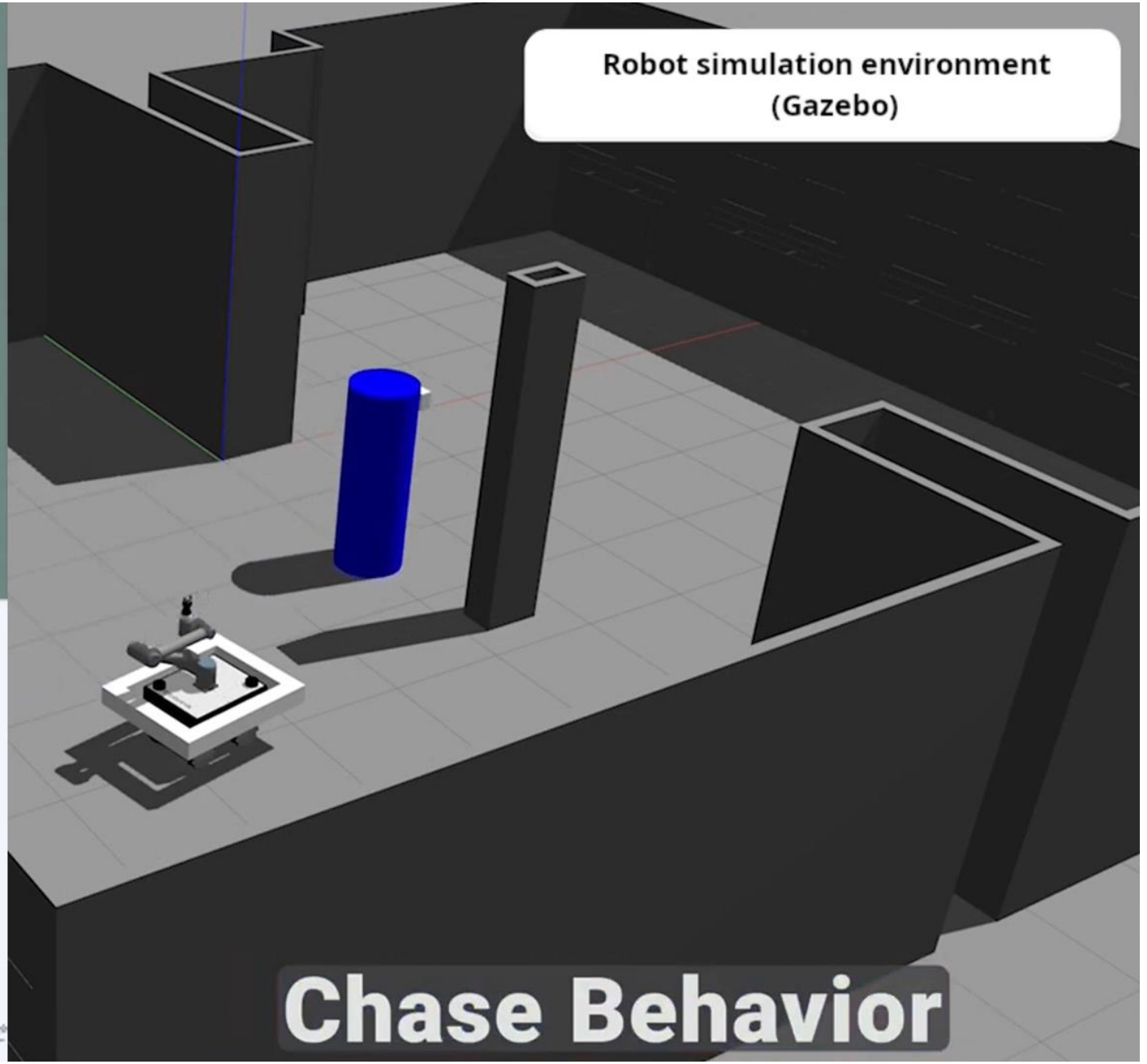
A Large-Scale Haptic VR Interactive System Using a Collaborative Mobile Robot






Robot data visualizer
(Rviz)

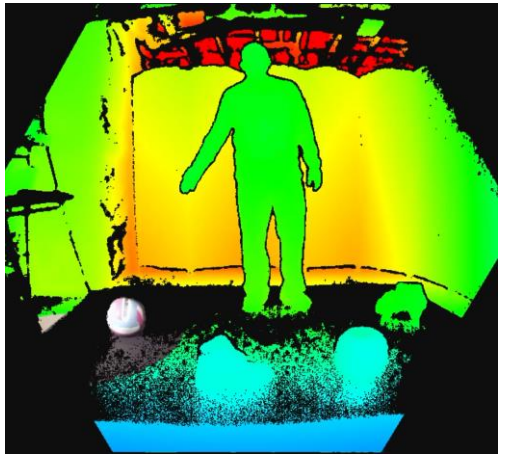

Robot behavior engine
(FlexBE)


Robot simulation environment
(Gazebo)
Chase Behavior

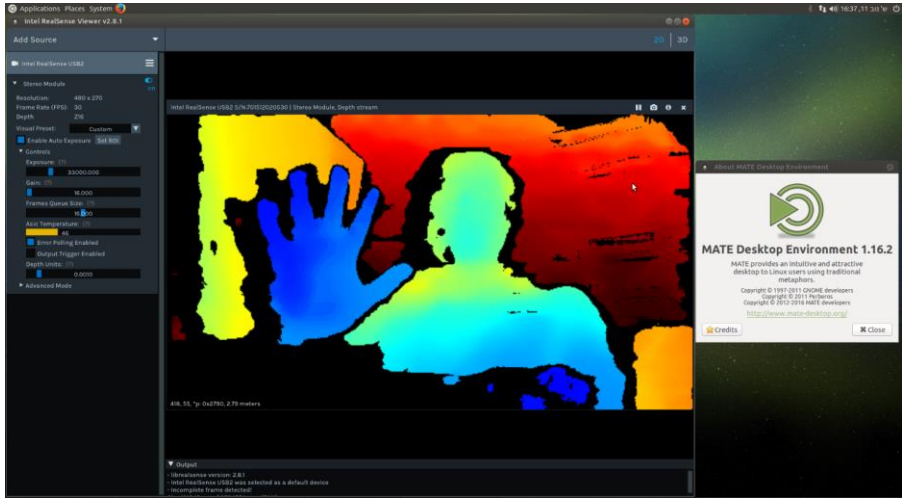
Virtual and Augmented Reality Group

Vision for Robot: Detect the VR User

- **Task**: Enable fast user detection on the robot for safety and interaction
  - Implement a solution for user detection:
    - Whole body or only hands/legs
    - Tell apart user from a static obstacle
    - Test for optimal recovery (collision avoidance) behavior
    - For thesis:
      - Explore options for time-optimization
      - Prepare and help running a user study

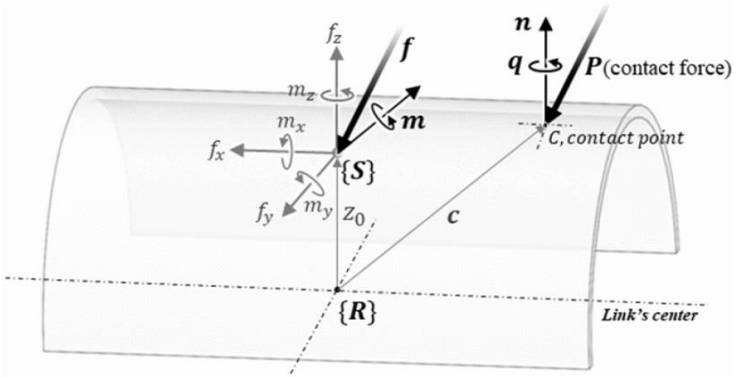


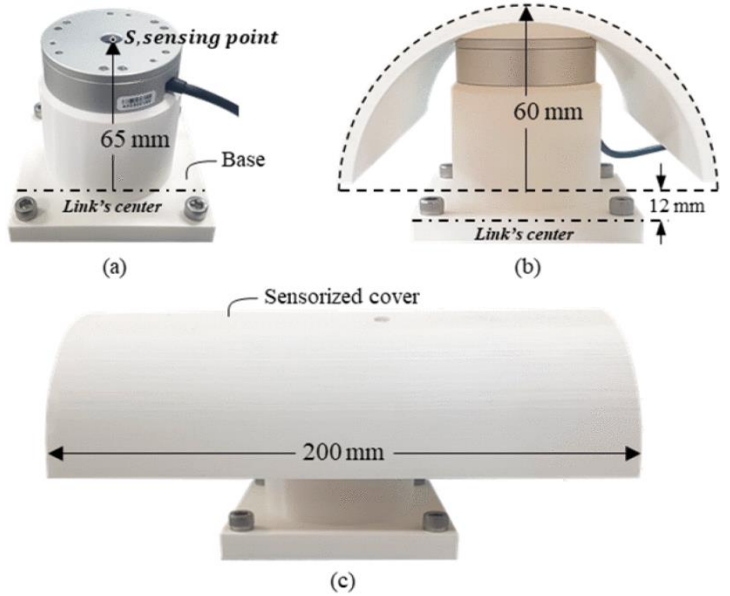
- **Setup/IDE:** Ubuntu, ROS (Robot Operating System), Azure Kinect
  Prerequisites: Basic Linux command, Python 2.7 & C++
  Scope: PR, Master thesis



Contact Point Sensing with Force Torque Sensor

- Sensing the contact point on a surface with a Force Torque Sensor in the center
- **Task:** Reimplementing a mathematically elegant approach, described in an existing paper. https://ieeexplore.ieee.org/document/9429923/media#media
- **Setup/IDE:** C++ and/or Python, ROS (Robot Operating System), if helpful Matlab/Octave
- **Prerequisites:** Programming with Python and/or C++, interested in mathematical problems
- **Scope**: PR, thesis





A Novel Intrinsic Force Sensing Method for Robot Manipulators During Human–Robot Interaction, Kim et al

Virtual and Augmented Reality Group

Interested in CoboDeck?

Supervisor:

- Khrystyna Vasylevska
- Emanuel Vonach
- Soroosh Mortezapoor
- Mohammad Ghazanfari

Send email for more information and discuss topics:

cobodeck@list.tuwien.ac.at

OTHERS

Suggest Your Topic!

- Additional topics available and added every semester on:
  - https://www.vr.tuwien.ac.at/topics/
- Suggest your own topic
  - If you have a topic that you feel very passionate about
  - If you want to make your own piece of equipment
  - Your topic has something in common with AR/VR or any of the topics above
- Feel free to contact Prof. Kaufmann *hannes.kaufmann@tuwien.ac.at*

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Questions?