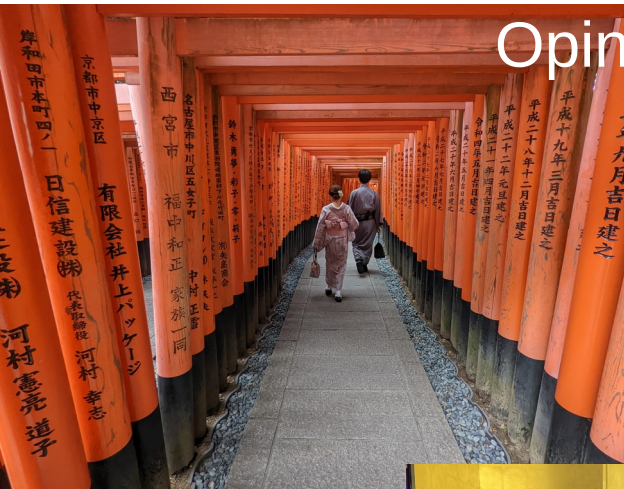
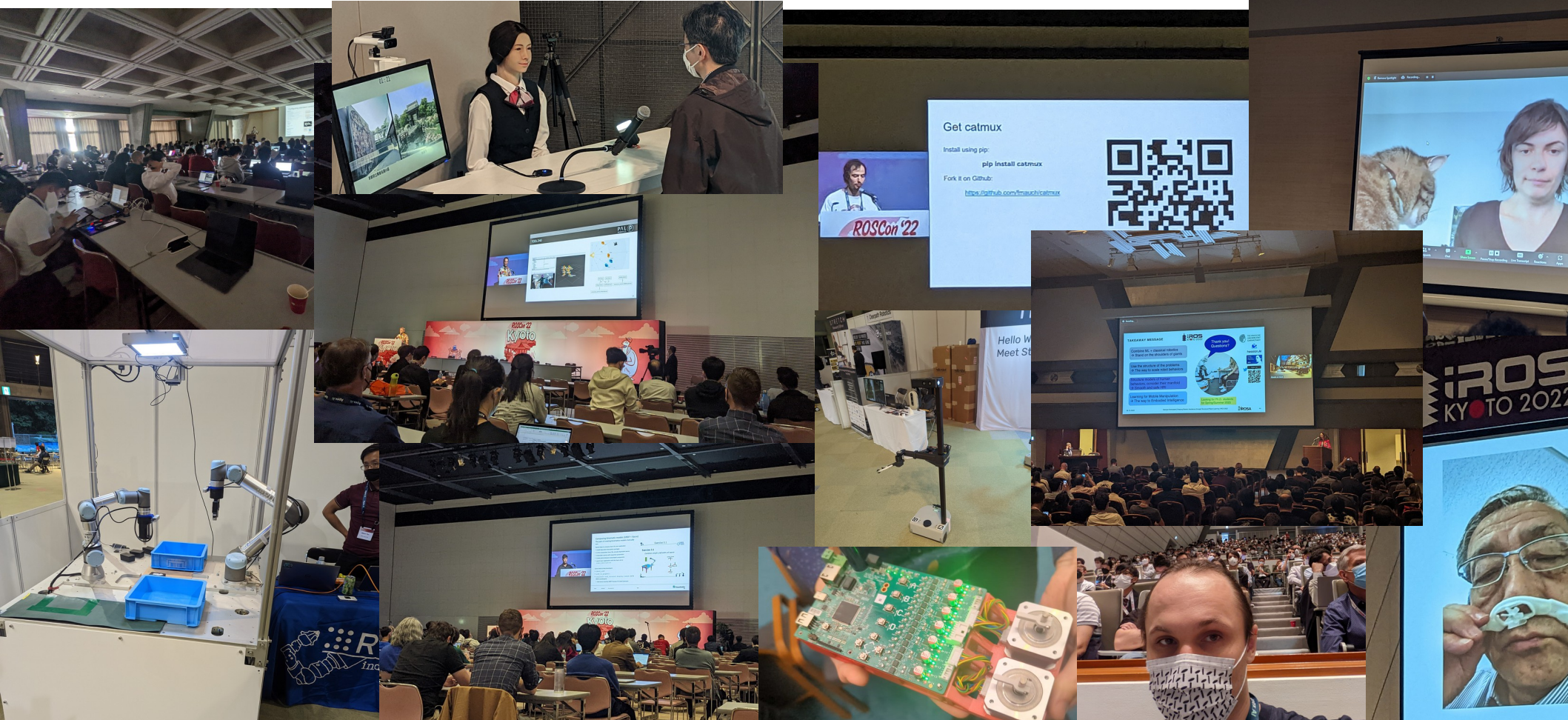


ROSCon / IROS 2022

Opinionated Report by Michael Görner



ROSCon / IROS 2022



ROSCon



ROSCon



760 801 attendees

38 countries

447 workshop attendees

First multilingual workshop

18 diversity scholars



ROSCon – ROS One / ROS2

What's Past the End? The Future of ROS One



Michael 'v4hn' Görner
Universität Hamburg

- Groups with high investment in ROS1 are interested in continuing ROS one past OR's support
- Both frameworks were prominently discussed
- Migration/hybrid scenarios mentioned as well
- rclpy was pretty much the running gag of the conference... who needs python/rclpy support anyway
- ... when you can have Rust/RustDDS/rclrust instead?

ROSCon – RoboStack



Anaconda packaged ROS1/ROS2 Packages with pinned dependencies.

- If all you ever need with ROS1 is python3.8 & Ubuntu 20.04 library versions this solves all your problems on any system.
Else...
- *Encountered problems while solving: package ros-noetic-ivcon-0.1.7-py38he9ab703_9 requires python, but none of the providers can be installed*
- Supports what they need (just as any other distributor)
- ROS-O collaboration in progress

ROSCon – JupyterLab



- Based on RoboStack
- In-Browser ROS/ROS2 programming
- Visualization/Control plugins
- Interactive URDF modelling
- Setup in at least two universities with a central server to facilitate teaching

- Might be an option for ItR?
- Useful for teaching in Python as long as no real robot is connected

ROSCon – ros2_control



ROSCon – ROS4HRI

The projection screen displays a presentation slide titled "TOOLING" by PAL ROBOTICS. The slide is divided into several sections:

- Speaker Photo:** A small image of a man in a colorful shirt speaking at a podium with a "ROSCon '22" sign.
- ROS Interface Screenshot:** A screenshot of a ROS environment showing a 3D visualization of a robot arm and a terminal window.
- Network Diagram:** A graph showing nodes (represented by colored circles) and their interconnections, likely representing a system architecture or dependency graph.
- Dependency Graph:** A hierarchical diagram showing the relationships between different ROS packages. It includes boxes for "lib1 (dev)", "lib2 (dev)", "lib3 (dev)", "lib4 (dev)", "lib5 (dev)", "lib6 (dev)", "lib7 (dev)", "lib8 (dev)", "lib9 (dev)", "lib10 (dev)", "lib11 (dev)", "lib12 (dev)", "lib13 (dev)", "lib14 (dev)", "lib15 (dev)", "lib16 (dev)", "lib17 (dev)", "lib18 (dev)", "lib19 (dev)", "lib20 (dev)", "lib21 (dev)", "lib22 (dev)", "lib23 (dev)", "lib24 (dev)", "lib25 (dev)", "lib26 (dev)", "lib27 (dev)", "lib28 (dev)", "lib29 (dev)", "lib30 (dev)", "lib31 (dev)", "lib32 (dev)", "lib33 (dev)", "lib34 (dev)", "lib35 (dev)", "lib36 (dev)", "lib37 (dev)", "lib38 (dev)", "lib39 (dev)", "lib40 (dev)", "lib41 (dev)", "lib42 (dev)", "lib43 (dev)", "lib44 (dev)", "lib45 (dev)", "lib46 (dev)", "lib47 (dev)", "lib48 (dev)", "lib49 (dev)", "lib50 (dev)", "lib51 (dev)", "lib52 (dev)", "lib53 (dev)", "lib54 (dev)", "lib55 (dev)", "lib56 (dev)", "lib57 (dev)", "lib58 (dev)", "lib59 (dev)", "lib60 (dev)", "lib61 (dev)", "lib62 (dev)", "lib63 (dev)", "lib64 (dev)", "lib65 (dev)", "lib66 (dev)", "lib67 (dev)", "lib68 (dev)", "lib69 (dev)", "lib70 (dev)", "lib71 (dev)", "lib72 (dev)", "lib73 (dev)", "lib74 (dev)", "lib75 (dev)", "lib76 (dev)", "lib77 (dev)", "lib78 (dev)", "lib79 (dev)", "lib80 (dev)", "lib81 (dev)", "lib82 (dev)", "lib83 (dev)", "lib84 (dev)", "lib85 (dev)", "lib86 (dev)", "lib87 (dev)", "lib88 (dev)", "lib89 (dev)", "lib90 (dev)", "lib91 (dev)", "lib92 (dev)", "lib93 (dev)", "lib94 (dev)", "lib95 (dev)", "lib96 (dev)", "lib97 (dev)", "lib98 (dev)", "lib99 (dev)", "lib100 (dev)".

The slide also features the PAL ROBOTICS logo in the top right corner and the number "16" in the bottom right corner.

ROSCon '22
Kyoto

ROSCon '22
Kyoto



ROSCon – better than xacro?

- Demonstrated EmPy and ERB as alternatives to xacro
- Motivated by city-level descriptions for simulation competitions
- Lacks a community in ROS, but **can** be much more compact

```
<?xml version="1.0"?>
<sdf xmlns:xacro="http://www.ros.org/wiki/xacro">
  <xacro:macro name="inertial_cylinder" params="mass radius length">
    <xacro:property
      name="xy"
      value="{mass * (3 * radius * radius + length * length) / 12.0}"/>
    <xacro:property
      name="z"
      value="{mass * radius * radius * 0.5}"/>
    <inertial>
      <mass>{mass}</mass>
      <inertia>
        <ixx>{xy}</ixx>
        <ixy>0.0</ixy>
        <ixz>0.0</ixz>
        <iyy>{xy}</iyy>
        <iyz>0.0</iyz>
        <izz>{z}</izz>
      </inertia>
    </inertial>
  </xacro:macro>
</sdf>
```

```
@{
xy = mass * (3 * radius * radius + length * length) / 12.0
z = mass * radius * radius * 0.5
}@
<inertial>
  <mass>@(mass)</mass>
  <inertia>
    <ixx>@(xy)</ixx>
    <ixy>0.0</ixy>
    <ixz>0.0</ixz>
    <iyy>@(xy)</iyy>
    <iyz>0.0</iyz>
    <izz>@(z)</izz>
  </inertia>
</inertial>
```

<https://github.com/chapulina/desplate>

ROSCon – Lightning Talks

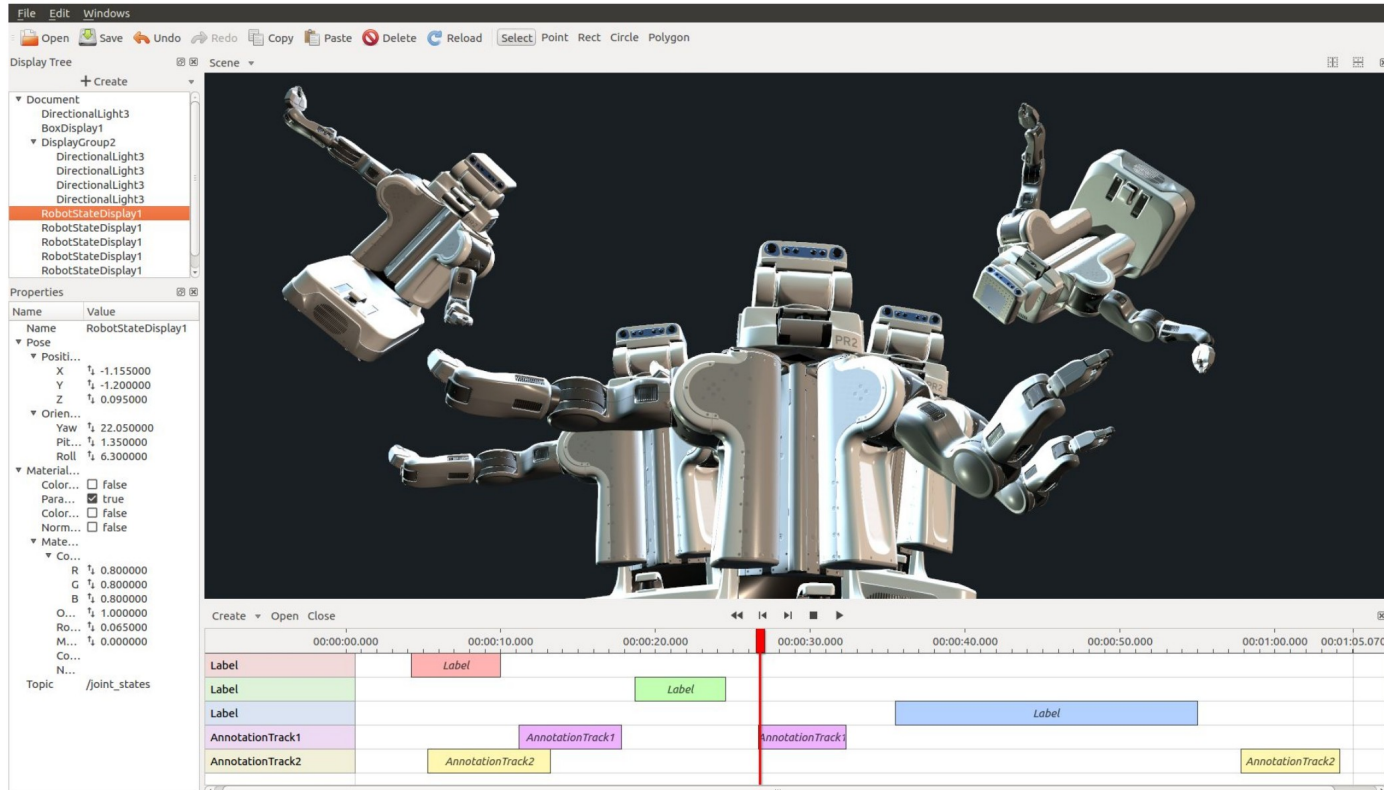


ROSCon – Lightning Talks



ROSCON – Lightning Talks

TAMSVIZ - <https://github.com/TAMS-Group/tamsviz>



ROSCon – Exhibits

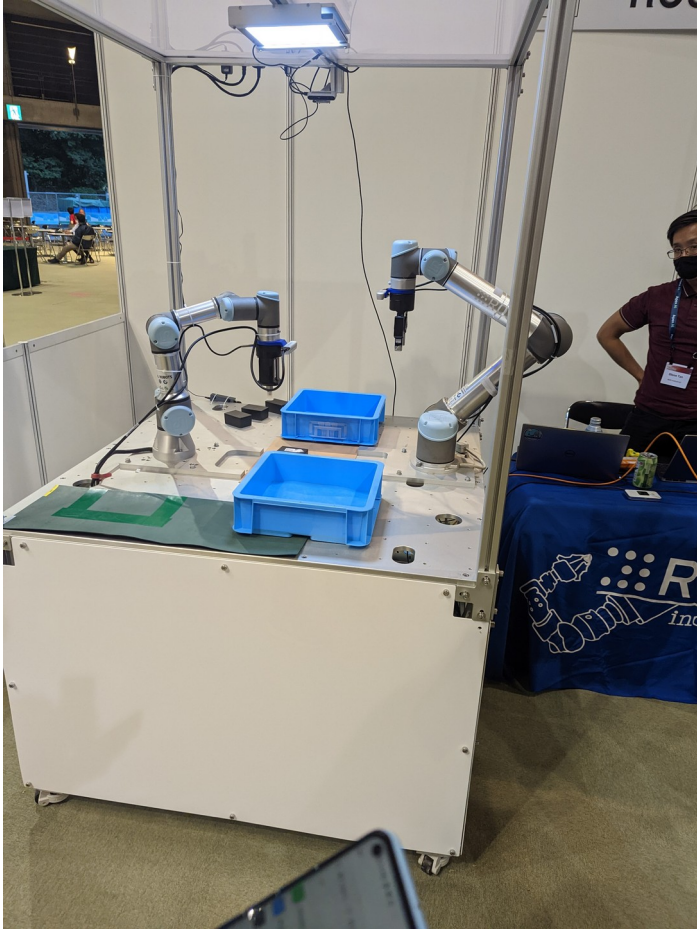


Turtlebot4

Again a well-integrated supported Turtlebot

- Demo robot for ROS2 navigation
- Raspberry Pi 4B (4 GB) – powered
- 2.500 €
- 7cm smaller than the turtlebot2
- ... missed the talk and didn't win the lottery :)

ROSCon – Exhibits



ROS-I workcell

- Integrated collision checking with `ros2_control JointTrajectoryController`
- https://github.com/ros-industrial/easy_manipulation_deployment

ROSCon – Exhibits



Crazyflie 2.1

SKU: 114991551

\$225.00 | \$281.25 inc VAT

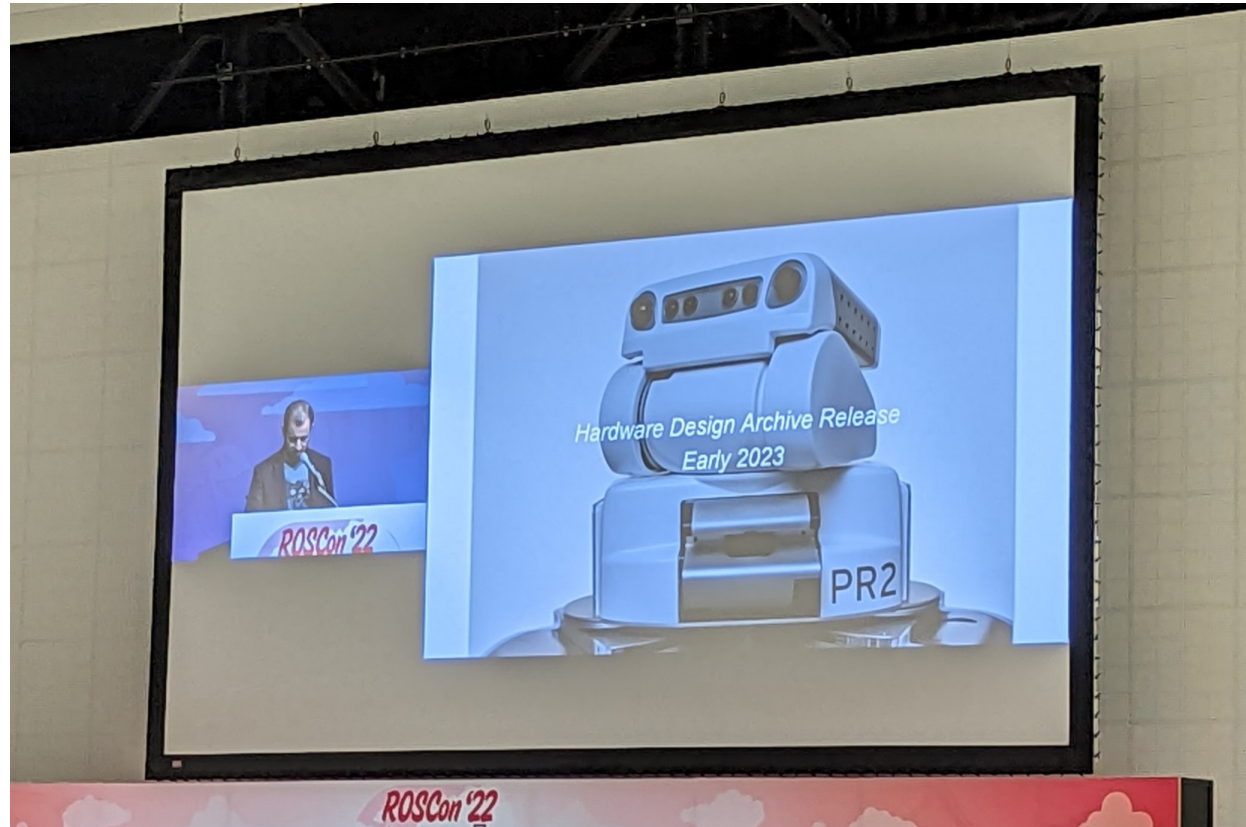
Add to Cart

The Crazyflie 2.1 is a versatile open source micro-robot, weighing only 27g and fits in the palm of your hand.

The Crazyflie 2.1 is a versatile open source micro-robot, weighing only 27g and fits in the palm of your hand. Crazyflie 2.1 features a long range radio as well as Bluetooth LE. This allows you to use your mobile device as a controller or your computer to display data and fly with a swarm.

The latest version of the successful Crazyflie 2.1 offers improved flight performance, durability and radio. It is part of a growing ecosystem of software and deck expansion modules for swarming.

ROSCon – PR2 Hardware Archive



Scott Hassan got divorced...



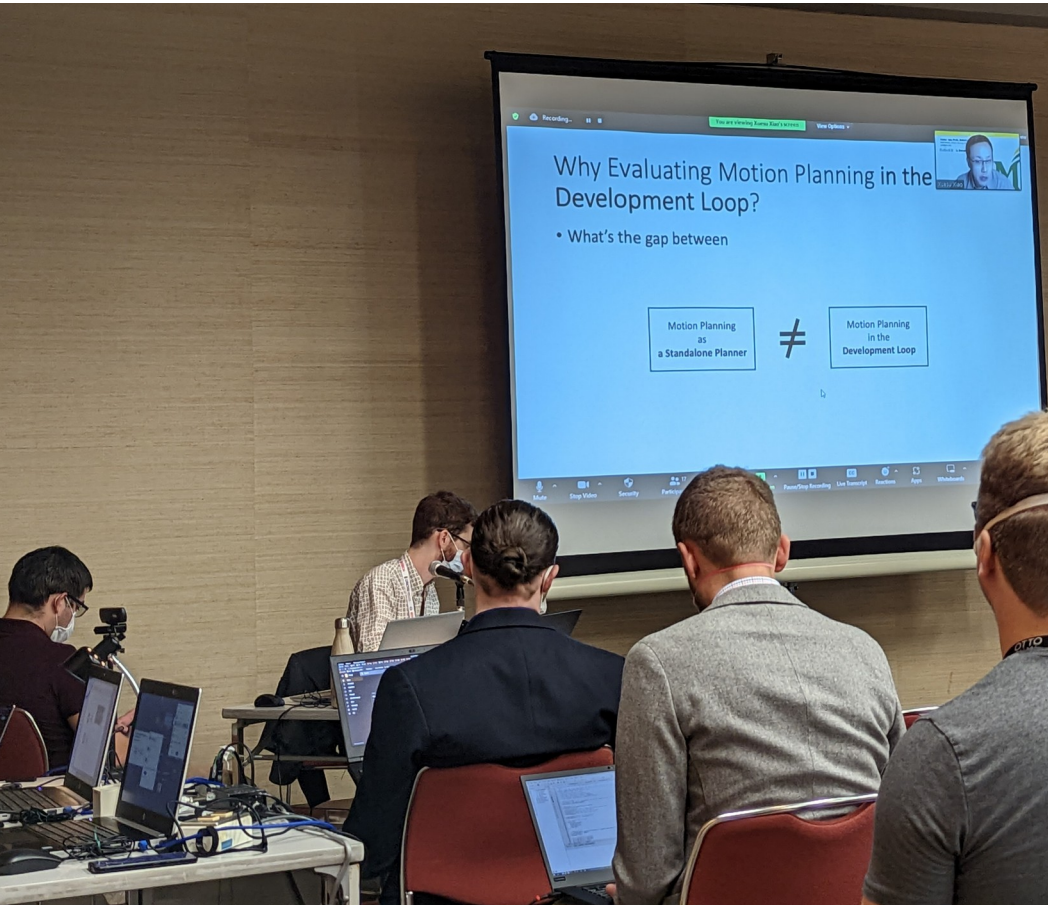
Workshops

Workshop EMPP

- Who (still) cares about evaluating Motion Planners? More than the organizers thought :-)



Workshop EMPP

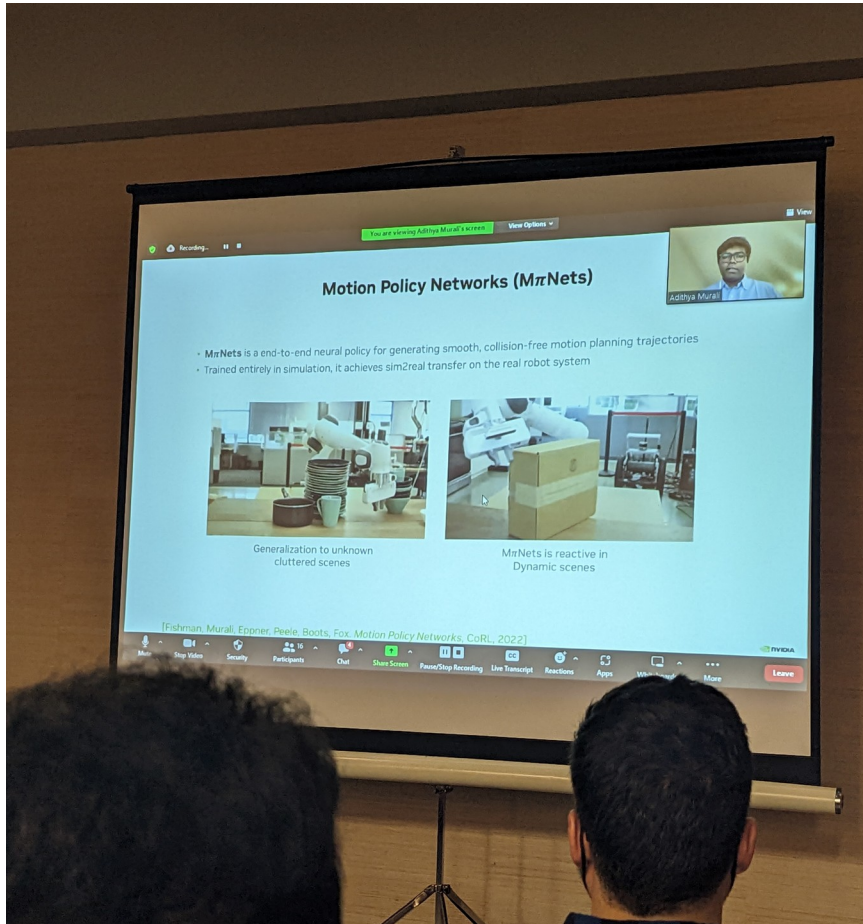


The two main motifs:

- Benchmark “in the loop”/in context instead of isolated motion plans/evaluate with Humans
- Let’s work on tuning Planners based on instance-level geometry
 - Planner Choice
 - Hyperparameters
 - Informed Sampling

M π Nets

- Improved alternative to MPNets
- From partial point cloud input
- Drastically improved success rate over MPNets

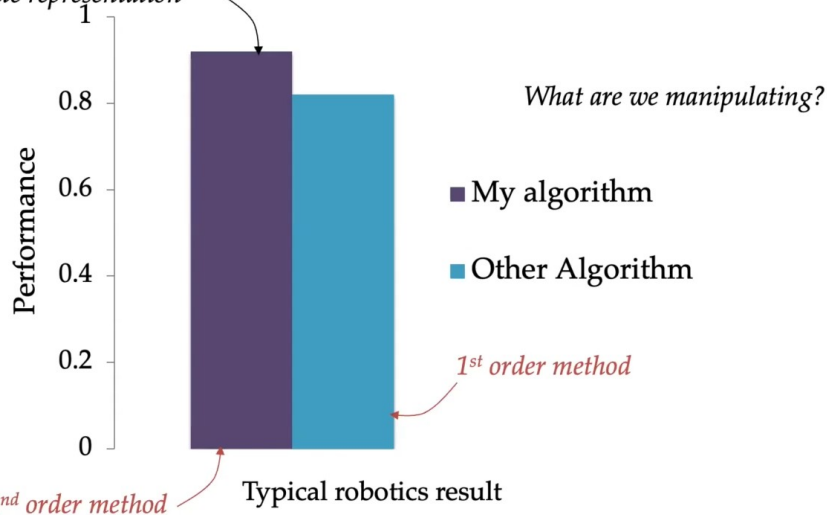


Anca Dragan (UC Berkeley)

Experimental Design

Good experiments **are factorial.**

improved state representation



Hypothesis ~ representing state in this and that way improves the dependent measure



Continuous Grasp Candidates

Neural Grasp Distance Fields (NGDF)

Key Idea: We represent grasps as a Neural Field

DeepSDF($\mathbf{q}_{xyz}, \mathbf{z}$) = d_{xyz}

Decision boundary of implicit surface
 $SDF > 0$
 $SDF < 0$

DeepSDF [1]

NGDF($\mathbf{q}_{pose}, \mathbf{z}$) = d_{pose}

Our Grasp Representation (NGDF)

Uhlenbrock, et al. "Deepsdf: Learning continuous signed distance functions for shape representation." Proceedings of the IEEE/CVF conference and pattern recognition. 2019.

SE(3) DIFFUSIONFIELDS FOR GRASP AND MOTION OPTIMIZATION

Obj

shape codes (II)

\mathbf{z}

sdf

flatten (III)

D_θ

e

$H \in SE(3)$

grasp pose

Pose to Points (I)

\mathbf{x}_w

world to object H_w^o

\mathbf{x}_o

F_θ

ψ

k

TECHNISCHE UNIVERSITÄT DARMSTADT

QR code

Uhlenbrock, J., Funk, N., Peters, J., and Chalvatzaki, G. SE(3)-DiffusionFields: Learning cost functions for joint grasp and motion optimization through diffusion. arXiv preprint arXiv:2209.03855.

TIROSA

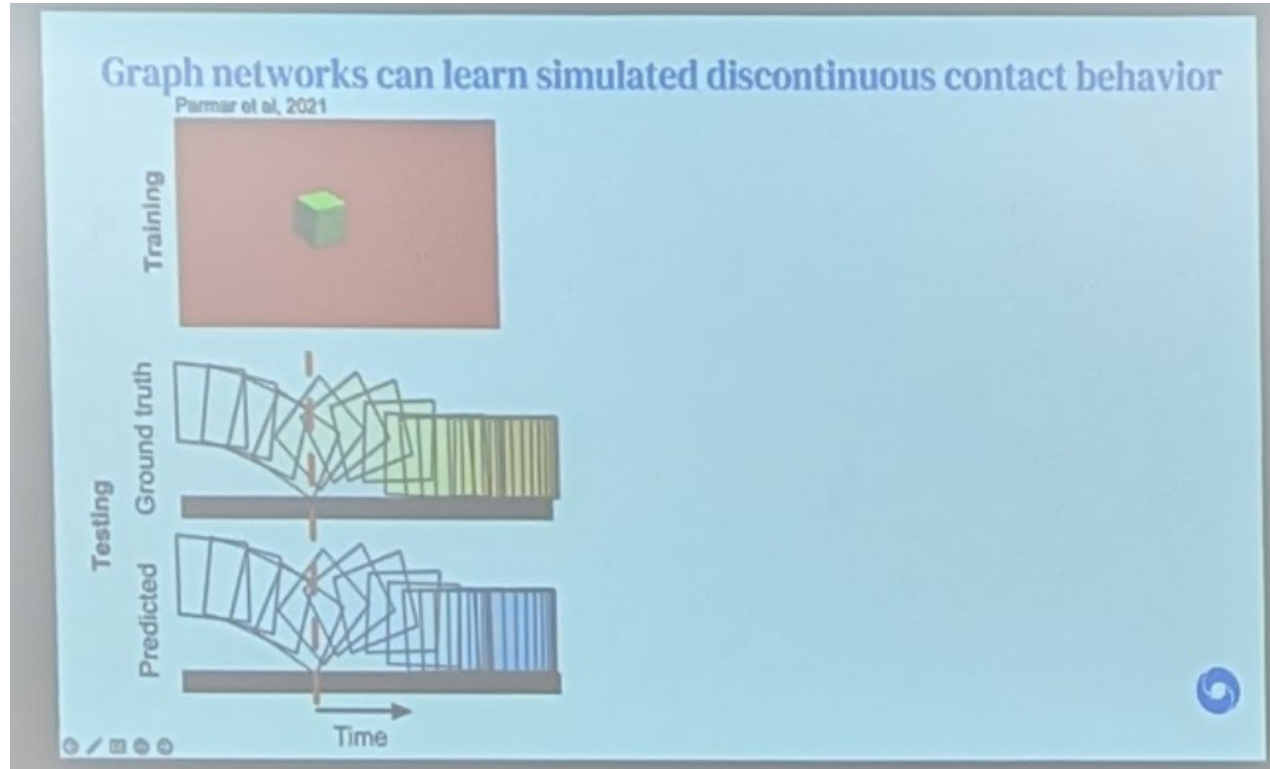
Mujin Robotics



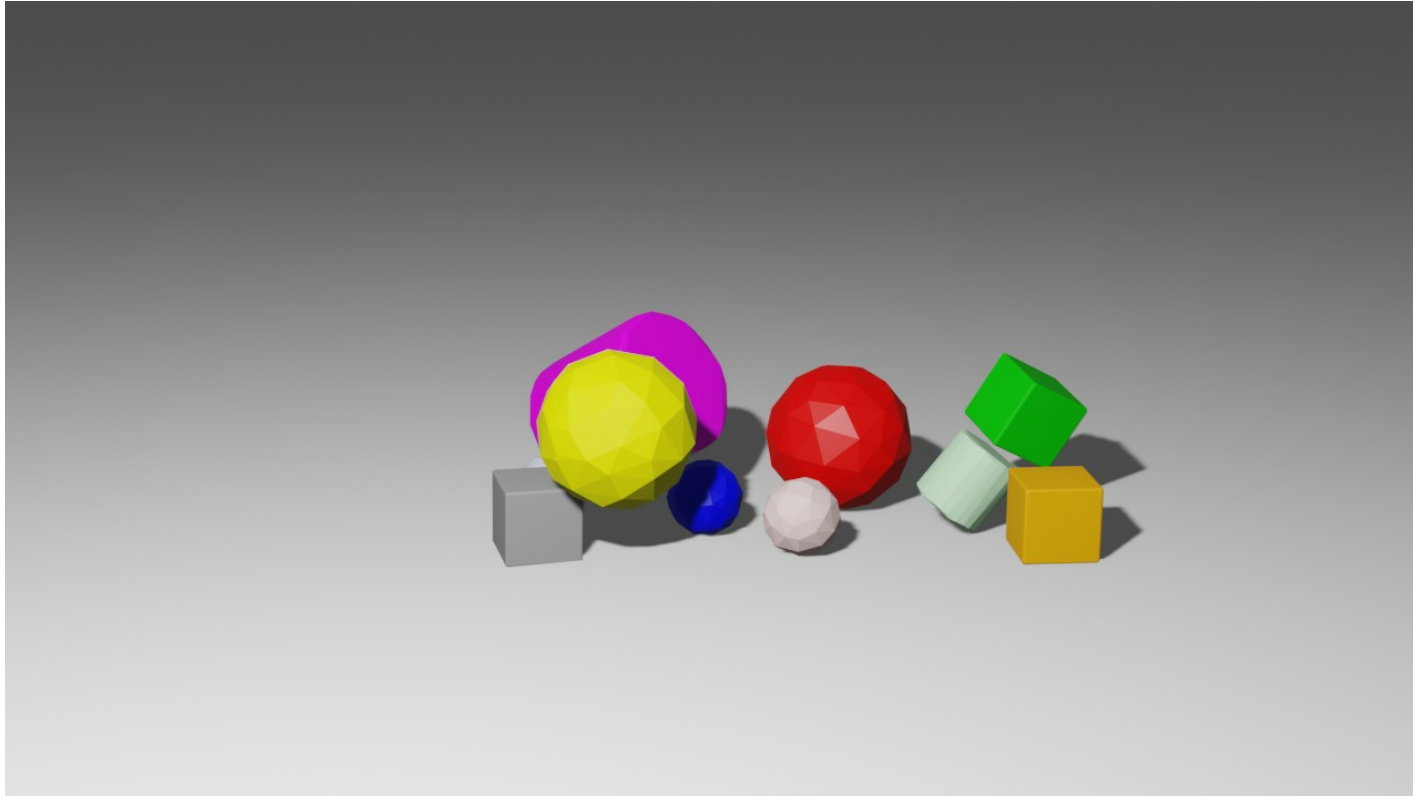
Main Takeaways:

- 99.9% is not enough
- Measure and validate as much as possible. Corner-cases arise
- Always consider alternatives in parallel
- More on Mujin and MechMind by Wenkai/Sam

Graph Network Simulators



Graph Network Simulators



ArmarX

The ARMAR Architecture

- **High-level (Planning and Reasoning)**
 - Natural language understanding, reasoning and planning
 - Plan Execution monitoring
- **Mid-Level (MemoryX)**
 - Mediator between sensorimotor data and symbolic knowledge
- **Low-Level (Behavior)**
 - Hardware Abstraction Layer (HAL)
 - Controllers

The diagram illustrates the ARMAR Architecture across three levels:

- High level:** Task Controller (Language Understanding, Replacement Manager, Plan Execution Monitor). It receives a **Domain Description** and sends **Action Selection** to the Mid level.
- Mid level:** MemoryX (Prior Knowledge, Long-term Memory, Working Memory, OAC Library). It receives **objects, actions, locations, agents, ...** and sends **Action Selection** to the Low level.
- Low level:** Hierarchical Statecharts (Grasp, Place, Wipe, ...), Hardware Abstraction Layer (Kinematics, Force Sensors, Cameras, ...), and Sensing & Control (ARMAR-III, ArmarX-YARP Bridge, ICub).

The diagram is presented on a screen with a presentation interface. At the top, it says "You are viewing Taneli Arvola's screen" and "View Options". At the bottom, there is a navigation bar with icons for Shop Video, Security, Participants, Chat, Share Screen, Record, Show Captions, Breakout Rooms, Reactions, Apps, Whiteboards, and More. The number "3" is visible in the bottom left corner of the slide. The KIT logo (Karlsruhe Institute of Technology) is in the top right, and the H2T logo is in the bottom right of the slide.

ArmarX

ArmarX Memory System: Functional View

Functionally, the memory system is split into **working, sensory and long-term memory**.

```
graph LR
    subgraph Hardware [Hardware Abstraction Layer]
        Robot[Robot]
    end
    subgraph Clients
        AC[Action Client]
        PC[Processing Client]
        SC[Sensor Client]
    end
    subgraph Memory
        WM[Working Memory]
        SM[Sensory Memory]
        LTM[Long-Term Memory]
        PK[Prior Knowledge]
    end
    Robot -- control --> AC
    AC -- query --> WM
    WM -- commit --> AC
    PC -- query --> WM
    WM -- commit --> PC
    Robot -- sense --> SC
    SC -- commit --> SM
    SM --> WM
    PK -- initialize --> WM
    WM -- query --> PK
    WM -- commit --> PK
    WM -- encode --> LTM
    LTM -- recall --> WM
```

15 → Data Flow

KIT Karlsruhe Institute of Technology

H2T

Stop Video Security Participants Chat Share Screen Record Show Captions Breakout Rooms Reactions Apps Whiteboards More End

RT as in ... Robotics Technology?

AIST

9:50-10:30, Oct. 27, 2022
IROS2022 Workshop:
Software and Control Architecture for Robotics

RT
MIDDLEWARE

RT-Middleware:
a robot software platform for model-based robot development

Noriaki Ando
Deputy Director, Industrial CPS Research Center,
National Institute of Industrial Science and Technology (AIST)

NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

Zoom Meeting Controls: Mute, Stop Video, Security, Participants, Chat, Share Screen, Record, Show Captions, Breakout Rooms, Reactions, Apps, Whiteboards, More, End

IAS-18 in 2023



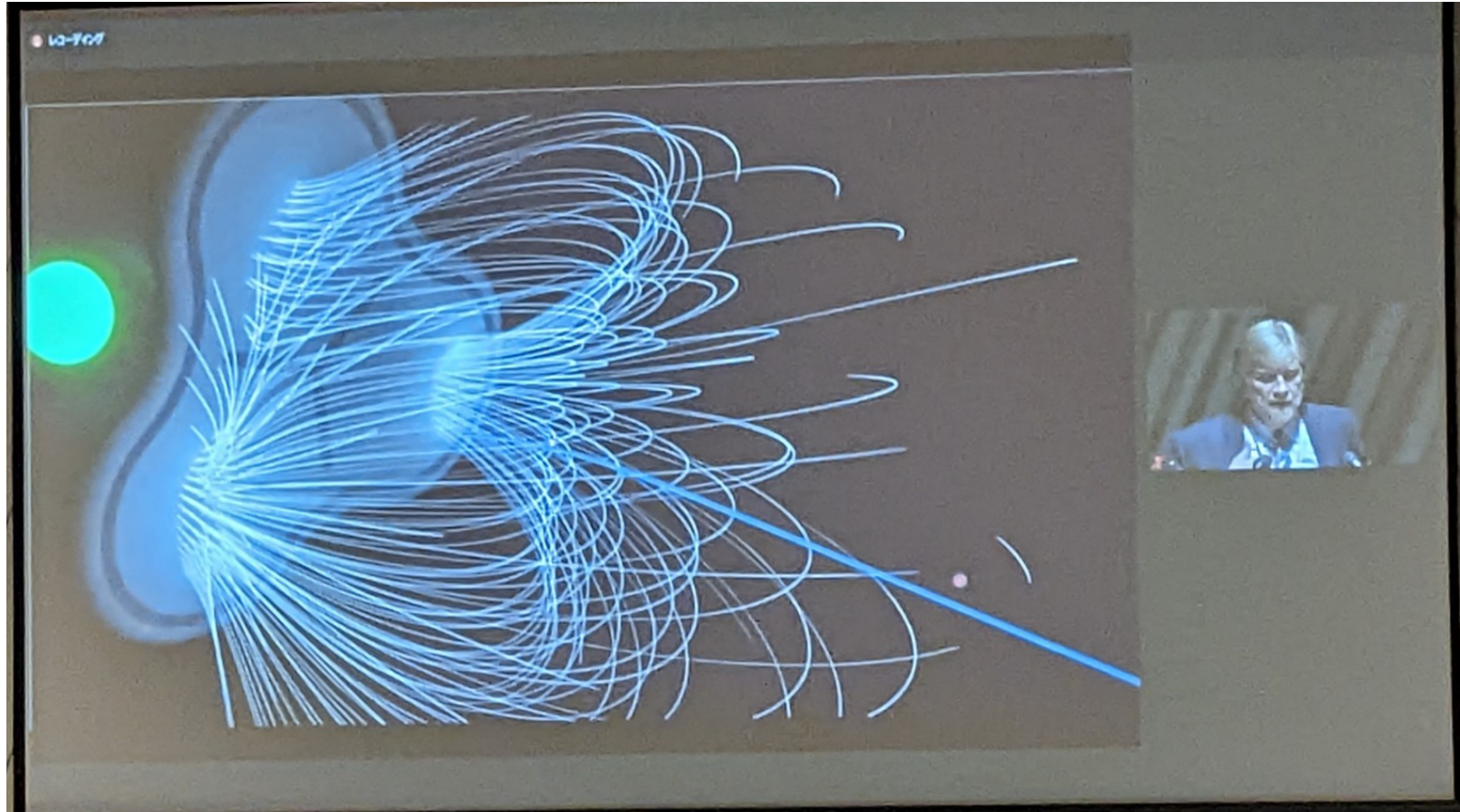
Deadline of Paper Submission
January 31, 2023

One more publication deadline
to publish **before** the CML review



1889 Accepted Papers

Brad Nelson Magnetic Navigation System

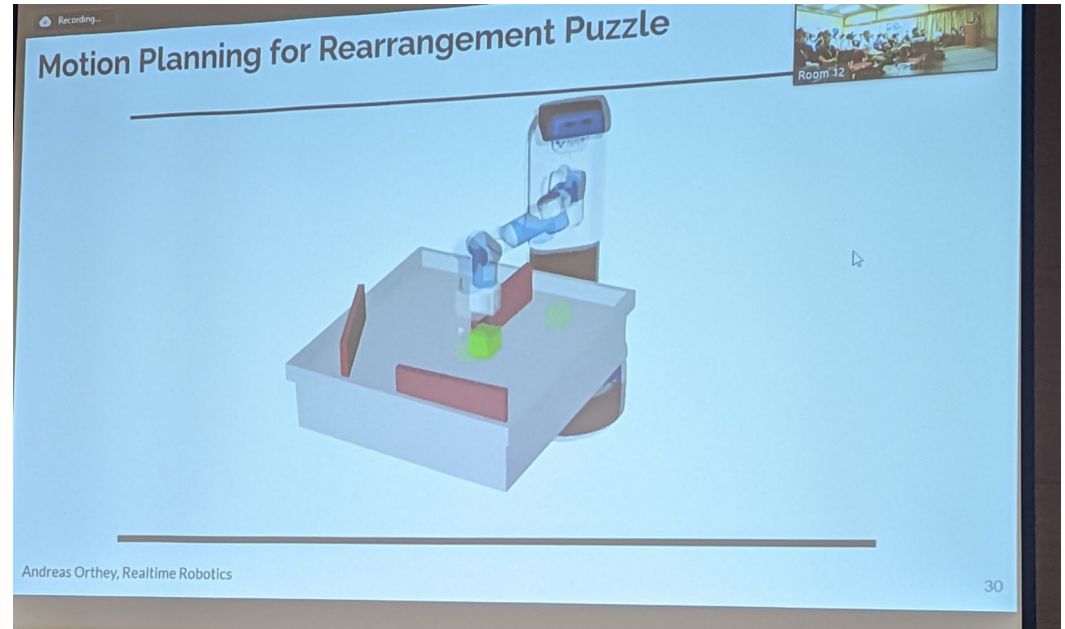
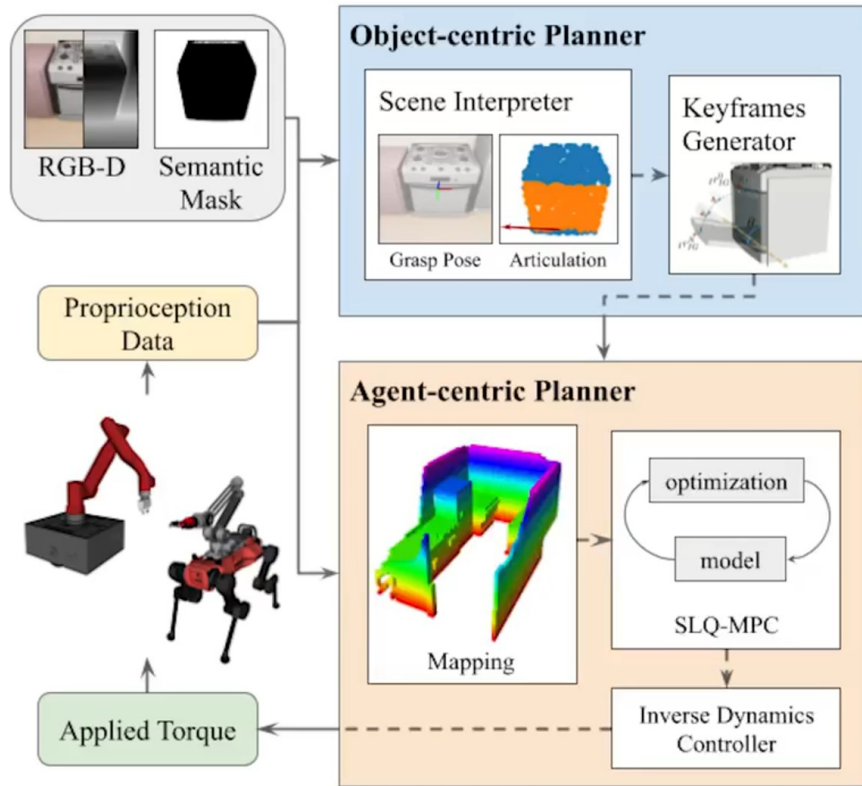


Brad Nelson

Magnetic Navigation System



Object-Centric Planning



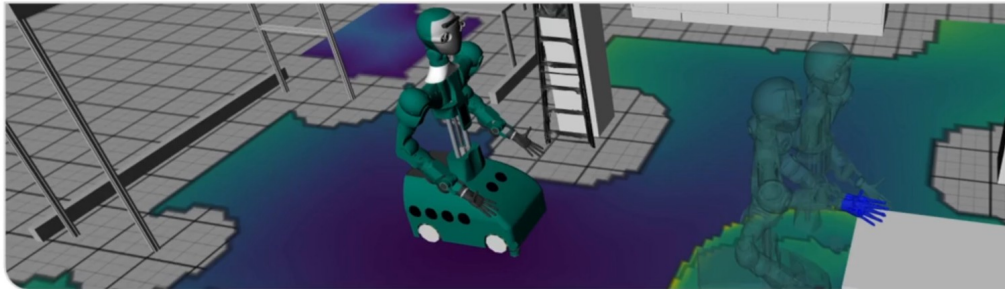
Andreas Orthey – EMPP Workshop

Base Placement



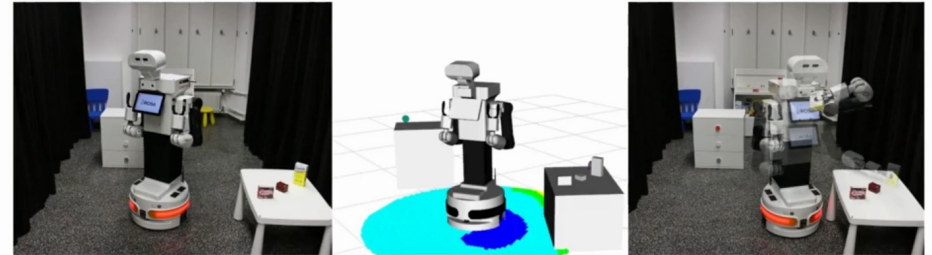
Combining Navigation and Manipulation Costs for Time-Efficient Robot Placement in Mobile Manipulation Tasks

Fabian Reister, Markus Grotz and Tamim Asfour

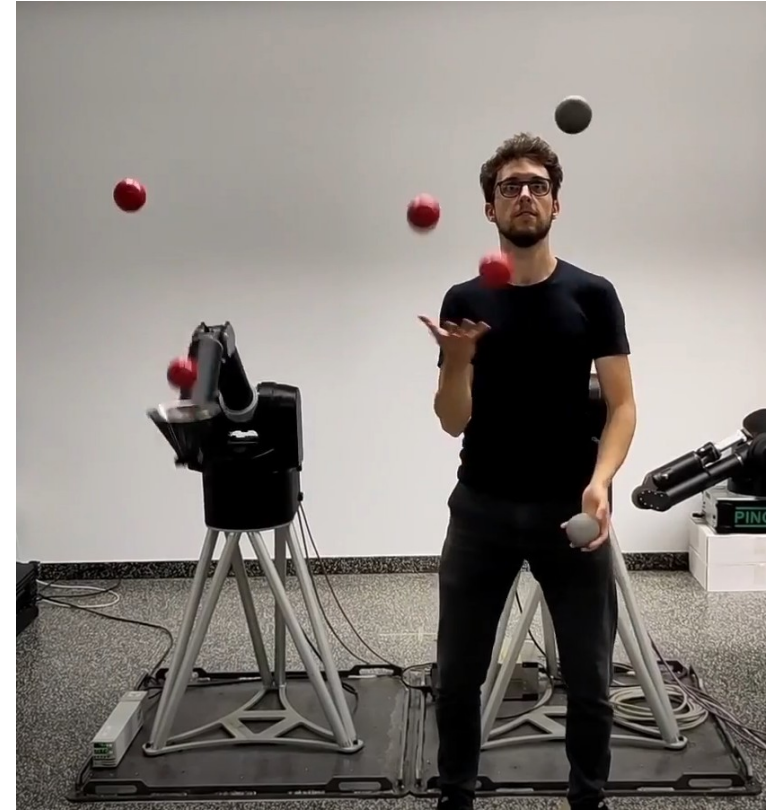
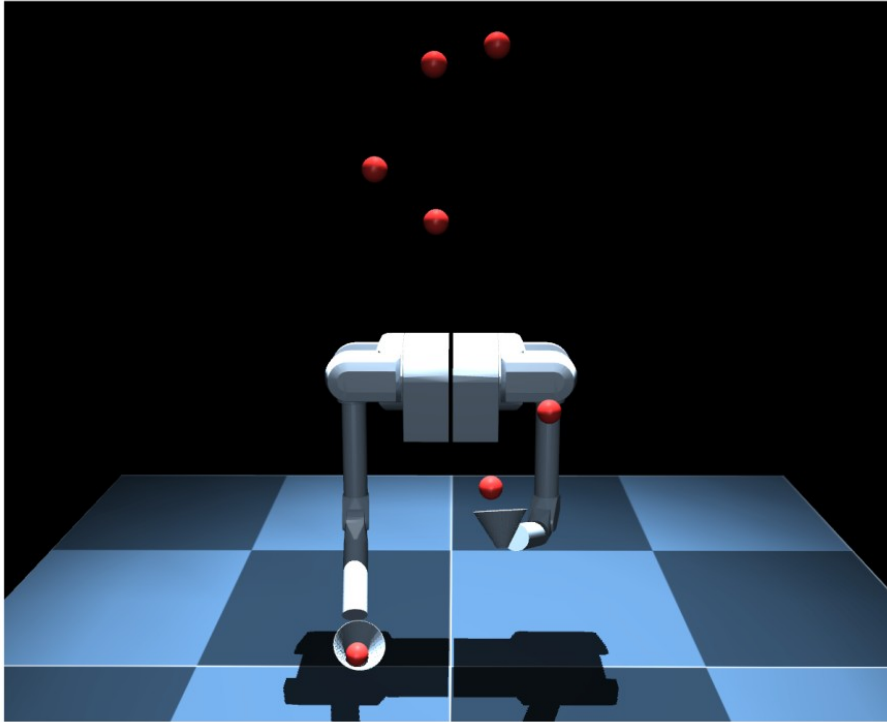


ROBOT LEARNING OF MOBILE MANIPULATION WITH REACHABILITY BEHAVIOR PRIORS

Snehal Jauhri, Jan Peters & Georgia Chalvatzaki



Juggling



Reversible SIFT

Motivation

A) Sending local features does not preserve privacy

Original Image

Preprocessed selected patch (64x64)

SIFT descriptor (128x1)

Reconstructed patch (64x64)

Generator

Generator is from a Generative Adversarial Network (GAN)

Pipeline for Patch reconstruction from a SIFT descriptor

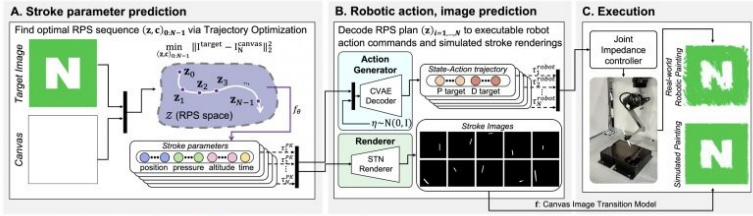
Example of reconstructed patches with groundtruth

ETH zürich Autonomous Systems Lab iROS KYOTO 2022

4

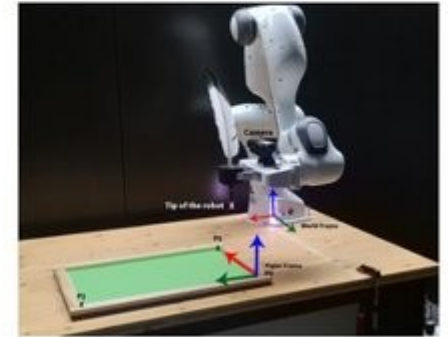
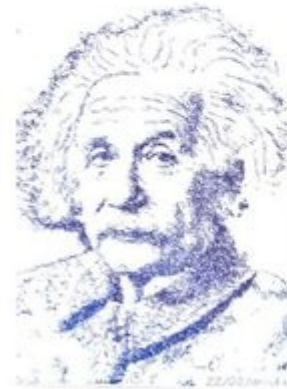
Don't Share My Face: Privacy Preserving Inpainting for Visual Localization
Himmi et al.

Drawing Bots

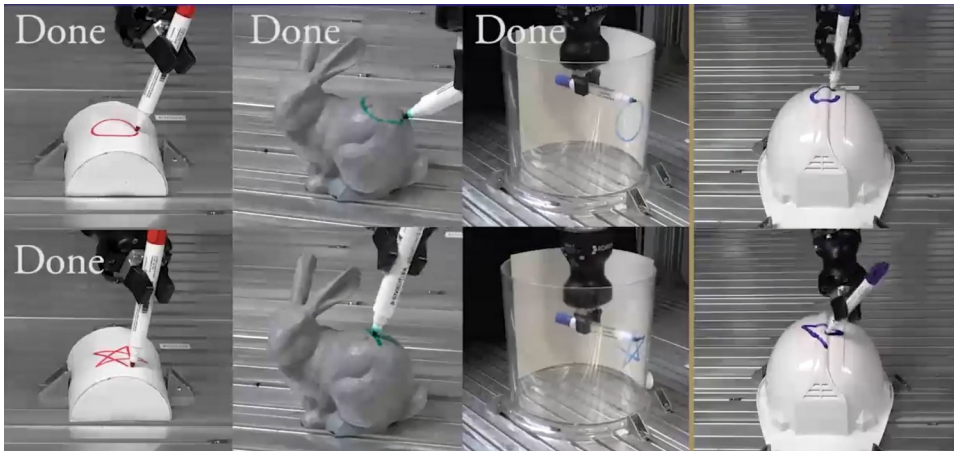


Robot Learning to Paint from Demonstrations – Park et al.

$$\frac{\partial}{\partial t} u(x, t) = \alpha \frac{\partial^2}{\partial x^2} u(x, t) + \beta s(x, t) - \gamma a(x, t)$$

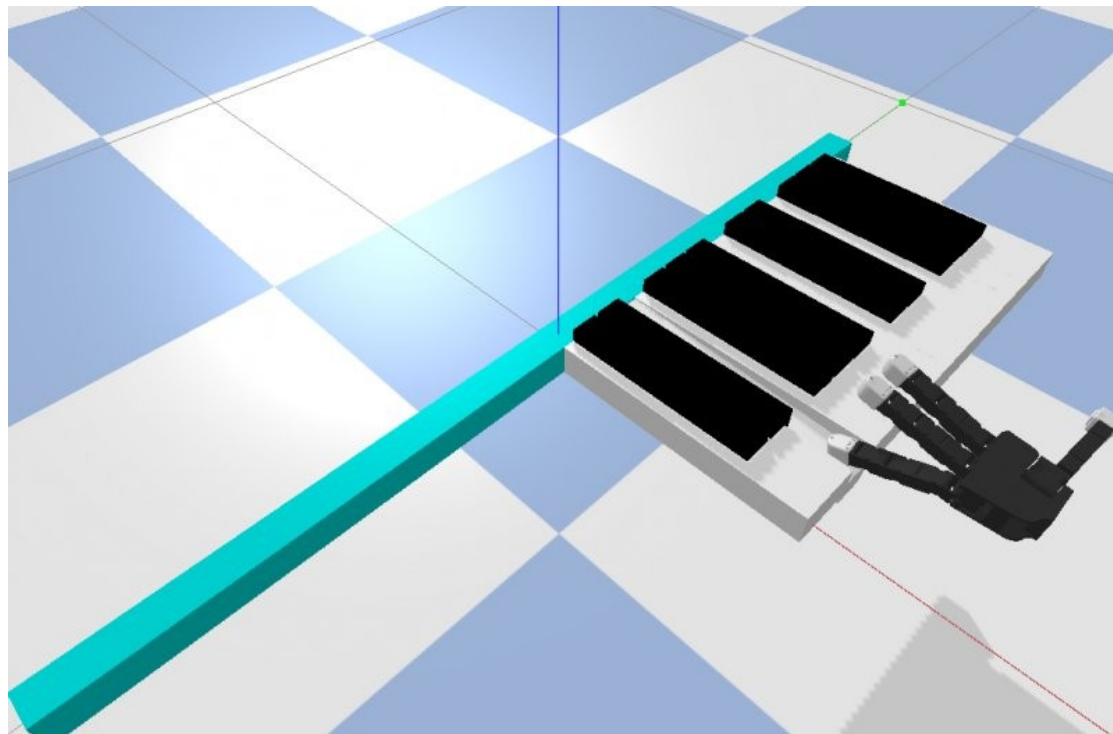


DrozBot: Using Ergodic Control to Draw Portraits
Löw et al.



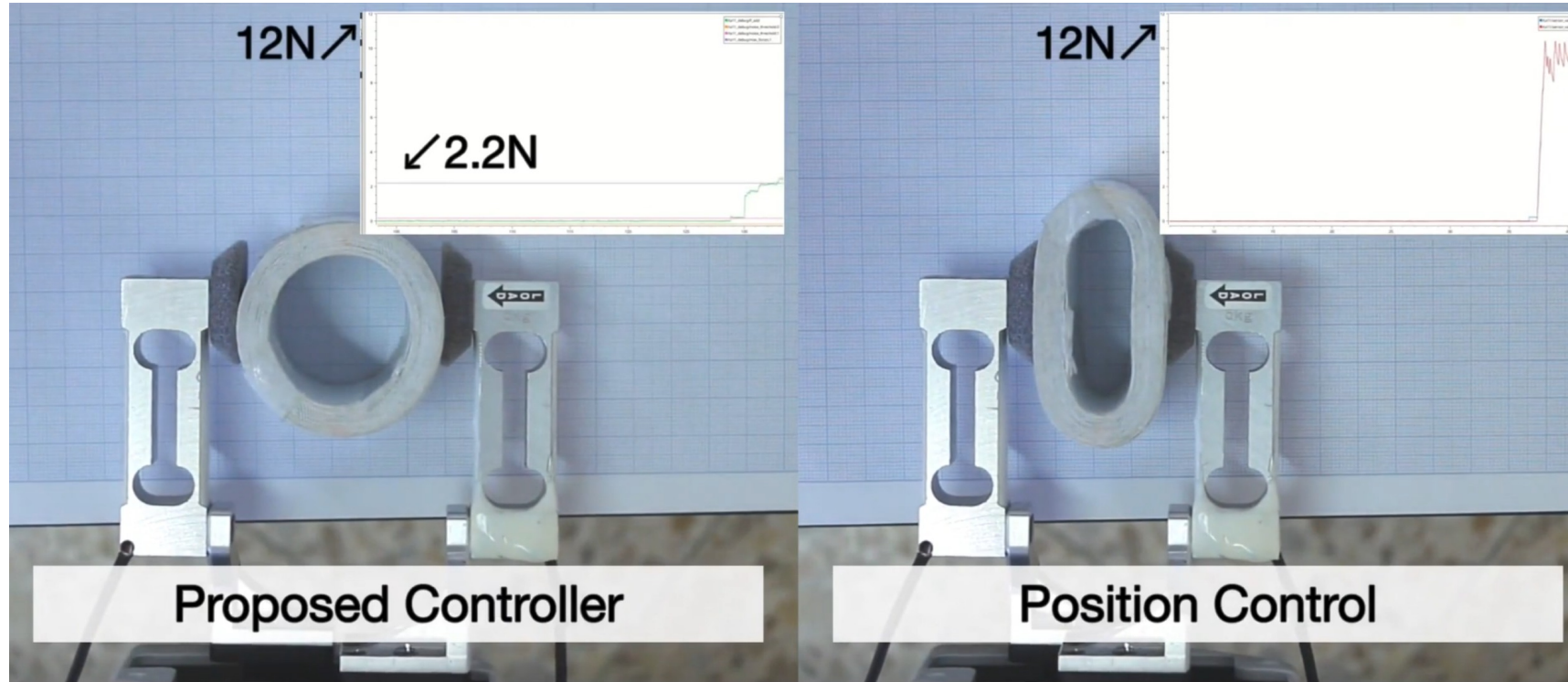
Robust Robotic 3-D Drawing Using Closed-Loop Planning
and Online Picked Pens – Liu et al.

RL for Playing Piano



Towards Learning to Play Piano with Dexterous Hands and Touch
Huazhe Xu, Yuping Luo, Shaoxiong Wang, Trevor Darrell, Roberto Calandra
Stanford, Princeton, MIT, UC Berkeley, Meta AI

Bielefeld / Helge Ritter



0585 - Bio-Inspired Grasping Controller for Sensorized 2-DoF Grippers

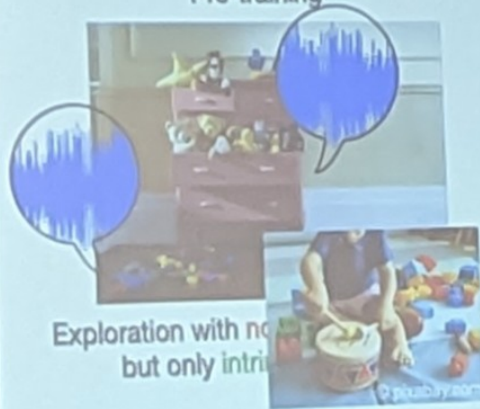
Luca Lach, Séverin Lemaignan, Francesco Ferro, Helge Joachim Ritter, Robert Haschke

Simulated Sound for URL

Motivation

- Unsupervised Reinforcement Learning (URL) [M. Laskin, 2021]

Pre-training



Exploration with no
but only intrinsic

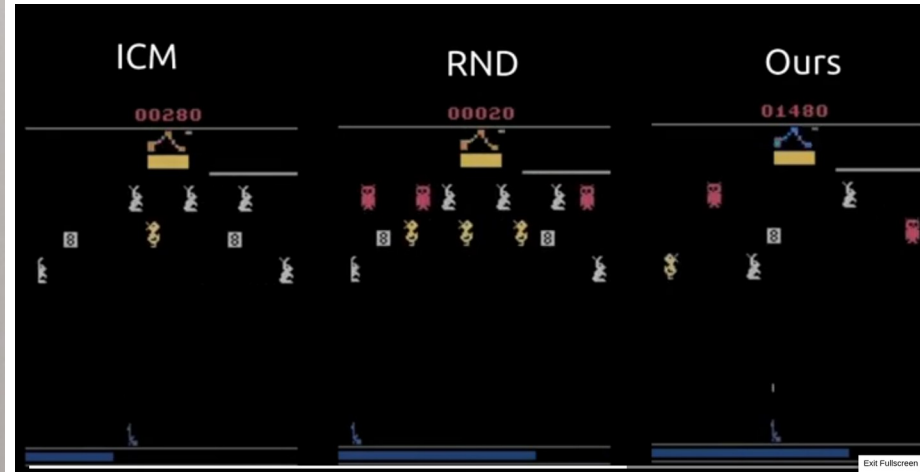
- Vision-Motor
 - Joint representation- and policy learning
- +Sound
 - Informative
 - Common, cheap
 - But less considered in RL Robotics



Xufeng Zhao et al.

Sound Guides Representations and Explorations 3

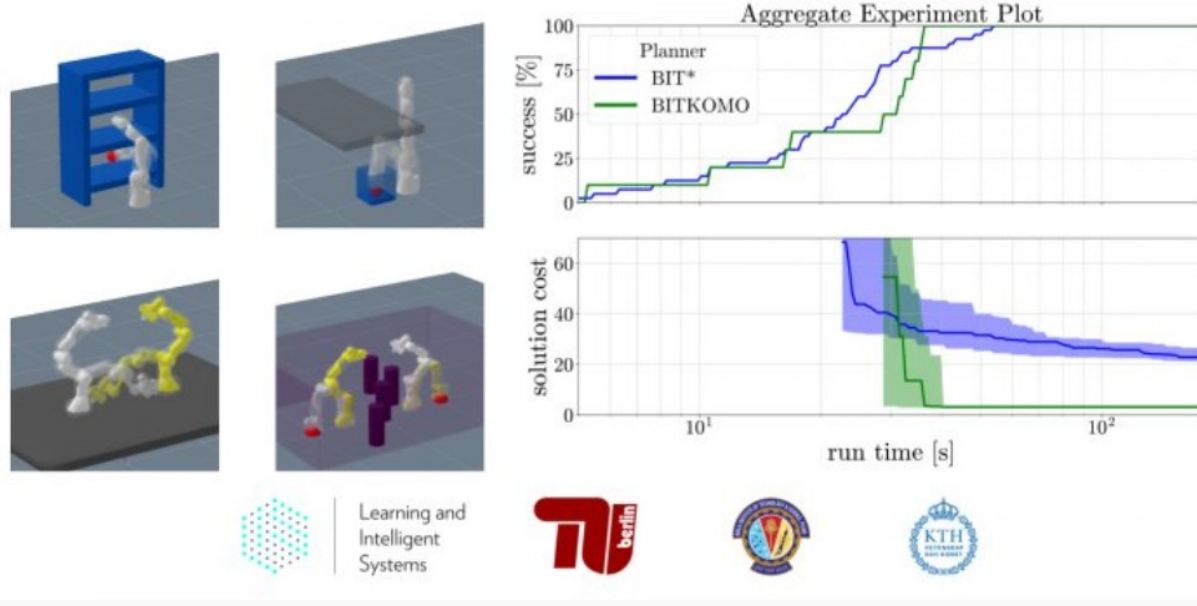
extracting features from high dimensional inputs.



Impact Makes a Sound and Sound Makes an Impact: Sound Guides Representations and Explorations
Noisy Agents: Self-Supervised Exploration by Predicting Auditory Events

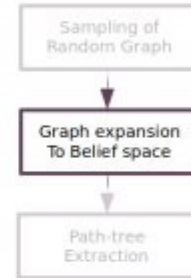
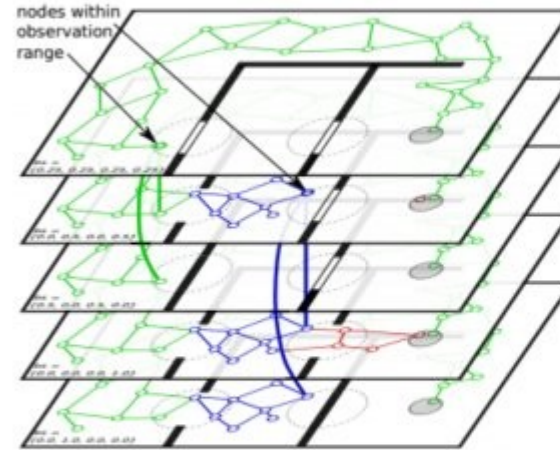
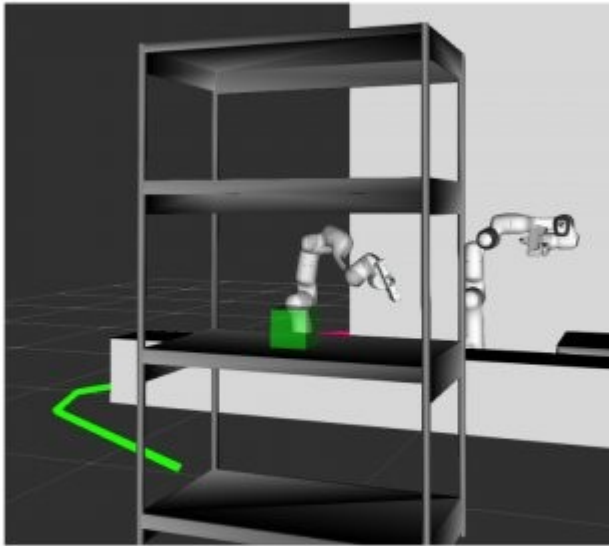
Combined Sampling & Optimization Planning

BITKOMO: Combining Sampling and Optimization for Fast Convergence in Optimal Motion Planning



Path-Tree Plans

Path-tree Optimization



Sampling based belief-space planner

Smooth MPPI without Smoothing



Dreamer/Dreaming/DreamingV2

Our contribution: DreamingV2


- Collaborative extension of DreamerV2 and Dreaming

```
graph TD; subgraph "continuous latent"; D["Dreamer [Hafner+, ICLR2020]"]; DV2["DreamerV2 [Hafner+, ICLR2021]"]; end; subgraph "Discrete latent"; Dm["Dreaming [Okada+, CRA2021]"]; DmV2["DreamingV2"]; end; D --> DV2; D --> Dm; Dm --> DmV2; N["New!"] -.-> DmV2;
```

- Discrete representation
⇒ suitable for discontinuous environments
- Reconstruction-free
⇒ well manages complex images

Playful Interactions



Playful Interactions



Easy data collection

Diverse scenes and environments

Collect 110 minutes of diverse, unstructured playful interaction data using the DemoAT reacher-grabber tool



Transformers



3D Part Assembly Generation with Instance Encoded Transformer

Rufeng Zhang¹, Tao Kong², Weihao Wang¹, Xuan Han¹ and Mingyu You¹
Tongji University¹, ByteDance AI Lab²
IEEE/RSJ International Conference on Intelligent Robots and Systems

When Transformer Meets Robotic Grasping: Exploits Context for Efficient Grasp Detection

Shaochen Wang, Zhangli Zhou, and Zhen Kan
University of Science and Technology of China, Hefei, China



MO-Transformer: A Transformer-Based Multi-Object Point Cloud Reconstruction Network

Erlu Lyu
Harbin Institute of Technology (Shenzhen)
IEEE/RSJ International Conference on Intelligent Robots and Systems

my name is Erlu Lyu and i'm from Harbin Institute of

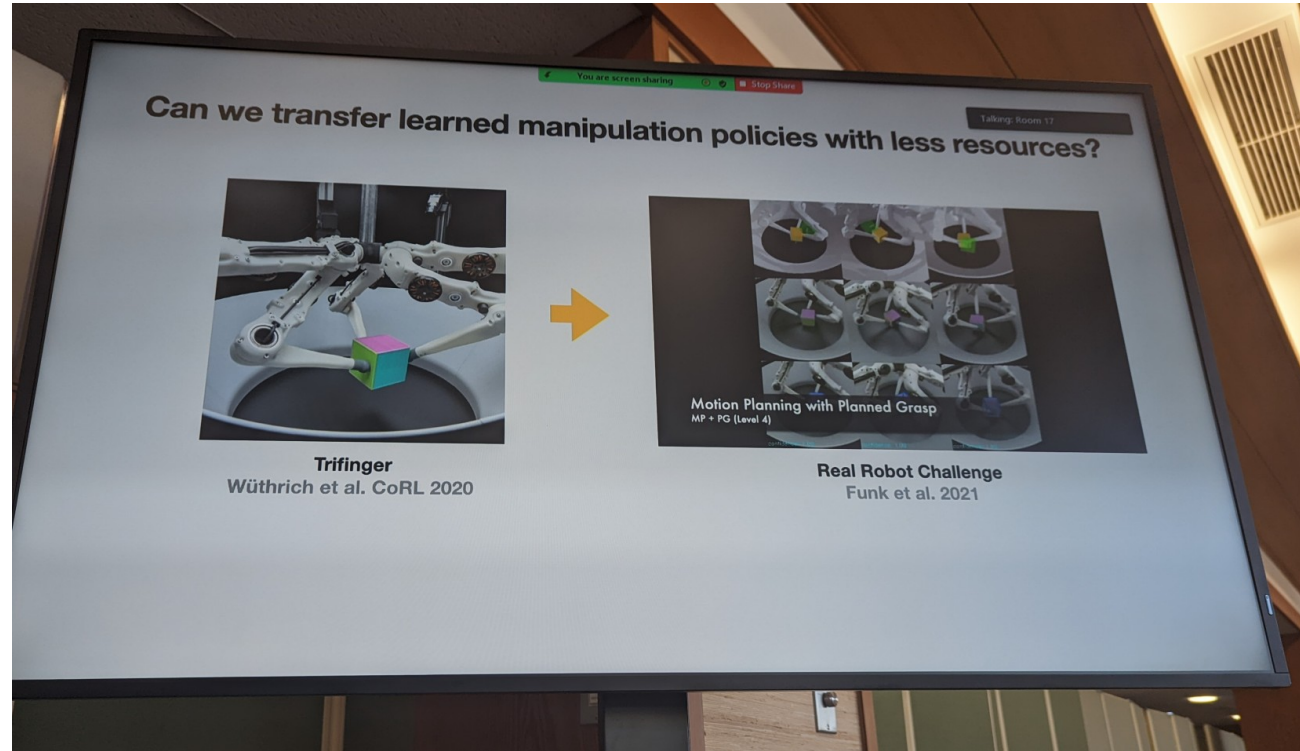


Human Trajectory Prediction with Group Aware Spatial-Temporal Transformer

Lei Zhou
Nankai University
IEEE/RSJ International Conference on Intelligent Robots and Systems

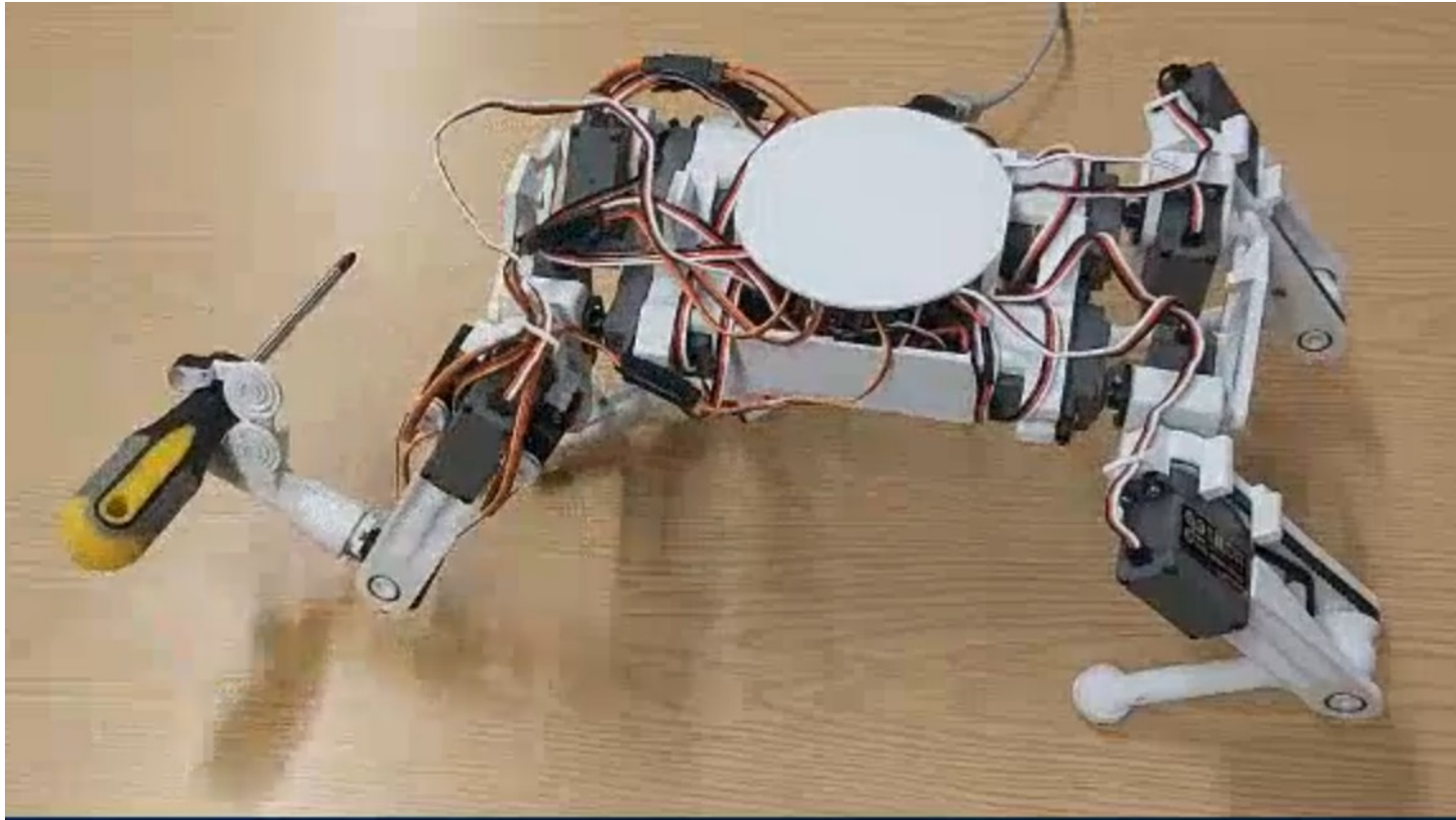


Object Reorientation

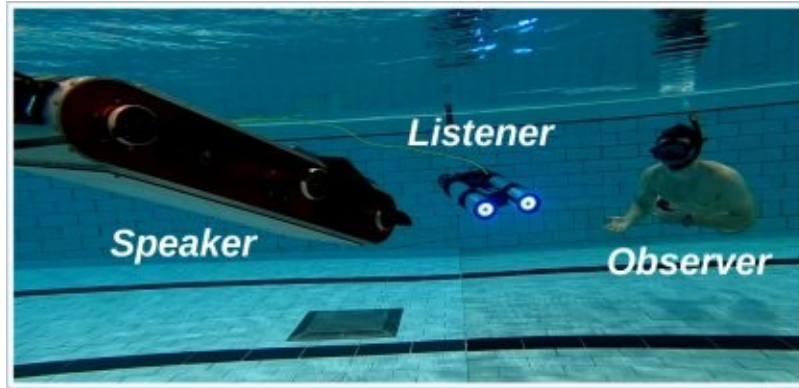


Transferring Dexterous Manipulation from GPU Simulation to a Remote Real-World TriFinger
Allshire et al.

Dactylus-Equipped Quadruped



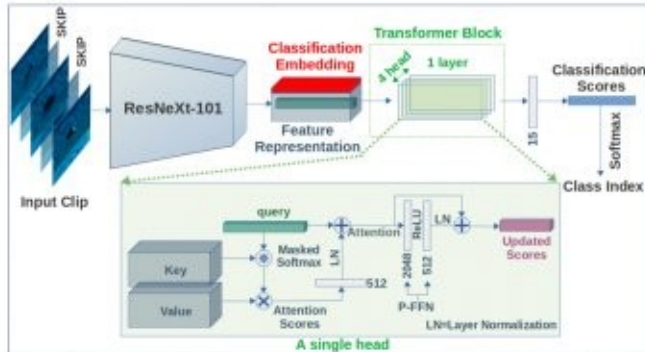
Kineme



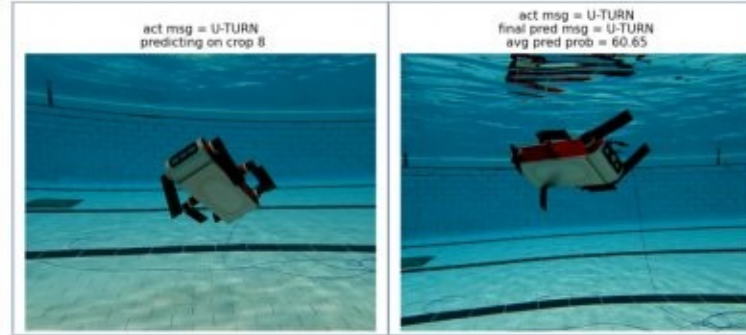
Multi-Human-Robot Interaction Scenario



Gestural Message

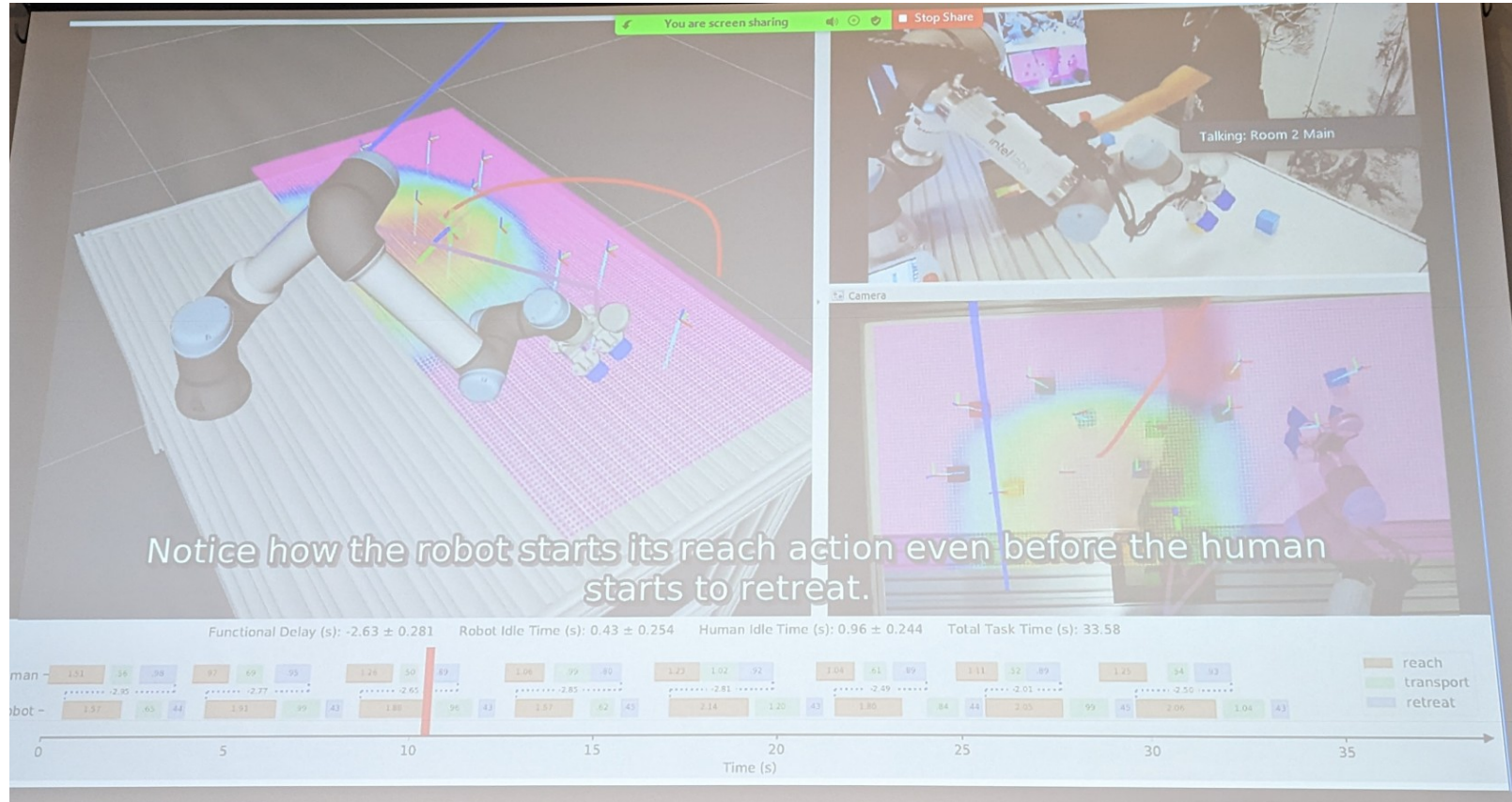


Gesture Recognition Network



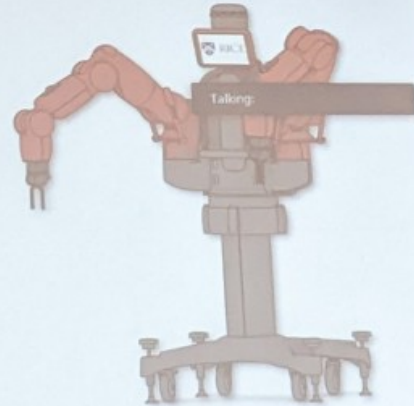
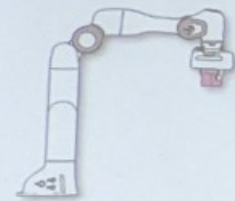
Gesture Recognition by AUVs

HRC in Reaching Tasks



Intuitive & Efficient Human-robot Collaboration via Real-time Approximate Bayesian Inference
Javier Felip Leo et al.

Robo(w)Flex



Robowflex: **Robot Motion Planning with MoveIt Made Easy**

Zachary Kingston & Lydia E. Kavraki

Rice University, Houston, TX

NSF 1718478, NSF 2008720, NSTRF 80NSSC17K0163



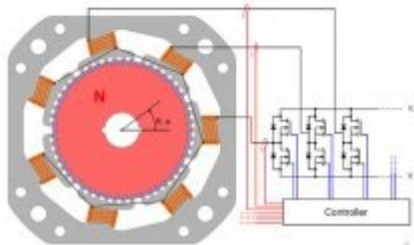
Kavraki Lab



Absolute Position Detection in 7-Phase Sensorless Electric Stepper Motor

Vincent Groenhuis
 Gijs Rolff
 Koen Bosman
 Leon Abelmann
 Stefano Stramigioli

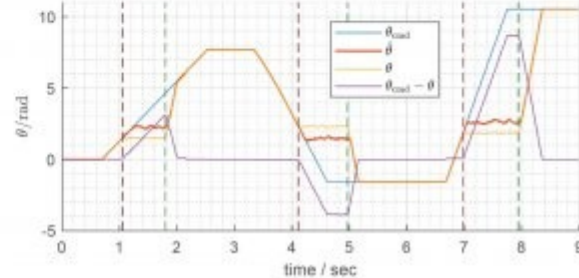
Robotics and Mechatronics,
 University of Twente



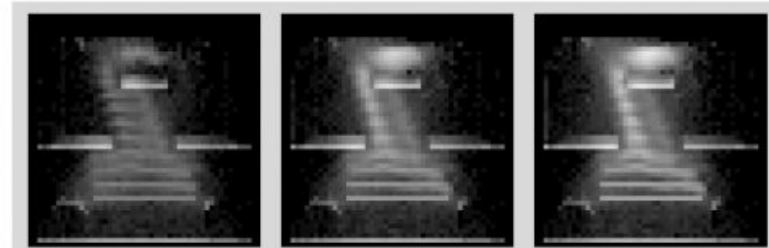
$$A_1 = \frac{7N_{\text{turns}} \Phi_0 \dot{\theta} w_1 n_1}{2R} e^{-50\theta}$$

$$\angle A_1 = -50\theta$$

500 and 520 are measurable!



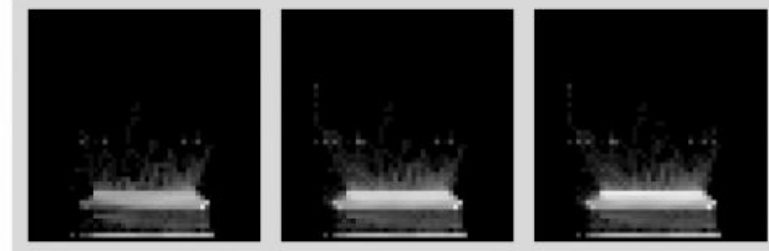
Active Exploration with MI Gain



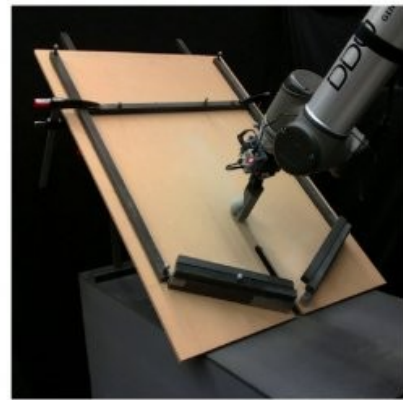
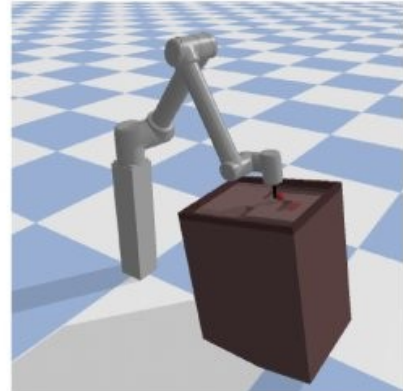
our information seeking agent

$$\max_{\pi} \text{MI}(\theta, (\mathbf{x}, \mathbf{r}, \mathbf{a}) \mid \pi, \mathbf{x}_t) + \beta \mathbb{E}_{P_{\pi}(r_{t+1:T})} \left[\sum_{\tau=t+1}^T r_{\tau} \right]$$

standard model-based RL



time →



Catching Drones

Aerial Grasping and the Velocity Sufficiency Region

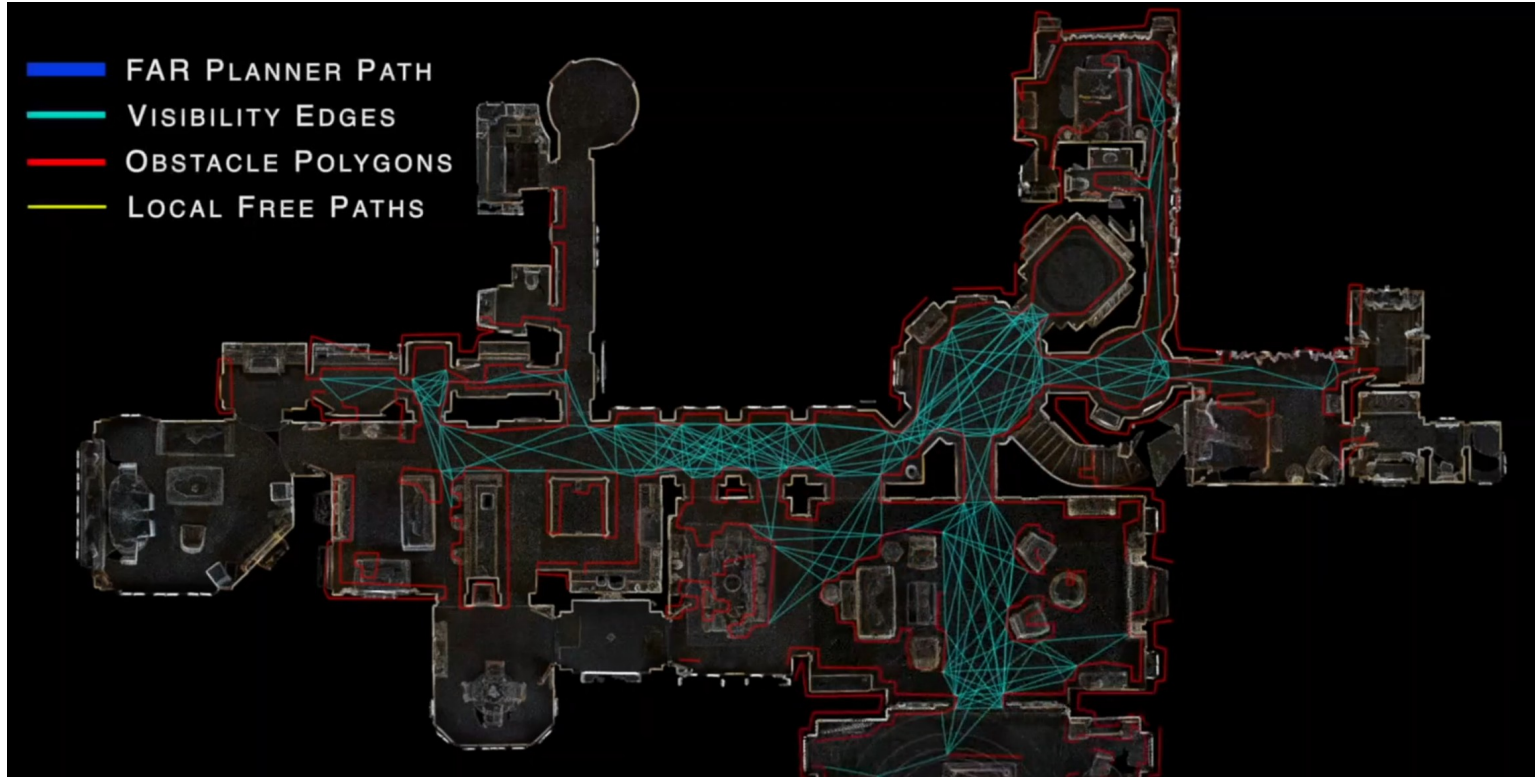
Tony Chen, Kenneth Hoffmann, Jun En Low, Keiko Nagami,
David Lentink, Mark Cutkosky

IROS-RAL 2022 Submission



Aerial Grasping and the Velocity Sufficiency Region
Chen et al.

Online Path Planning in Visibility Graph



FAR Planner: Fast, Attemptable Route Planner Using Dynamic Visibility Update
Yang et al.

IROS Best Paper - SpeedFolding



Yahav Avigal, Lars Berscheid, Tamim Asfour, Torsten Kröger , and Ken Goldberg

<https://pantor.github.io/speedfolding>