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CORSMAL

Collaborative Object Recognition, Shared Manipulation And Learning

ORMR (2019-2022)
Object Recognition and Manipulation by Robots:
data sharing and experiment reproducibility

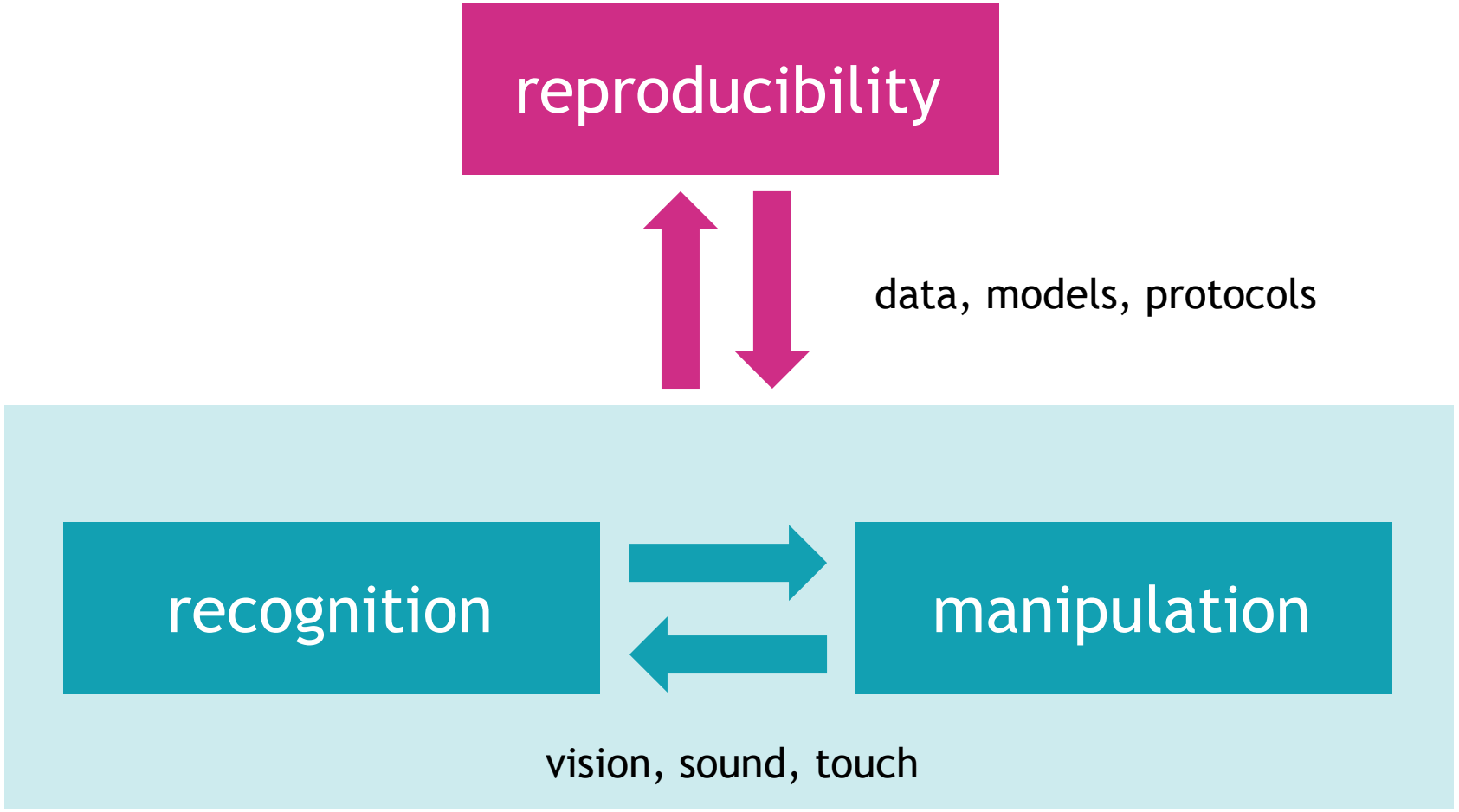
CHIST-ERA Workshop on Open Science in Transnational Research

Queen Mary University of London

SORBONNE UNIVERSITÉ

EPFL

Scope


reproducibility
data, models, protocols
recognition
manipulation
vision, sound, touch

Aims

- To create an open dataset and an evaluation protocol for recognition and manipulation of previously unseen objects

- To explore the fusion of multiple sensing modalities (touch + sound + vision) to accurately and robustly estimate the physical properties of objects in noisy and potentially ambiguous environments

The task

Human manipulation

Human-robot handover

Robot manipulation

Start:
Human grasping

End:
Robot delivery

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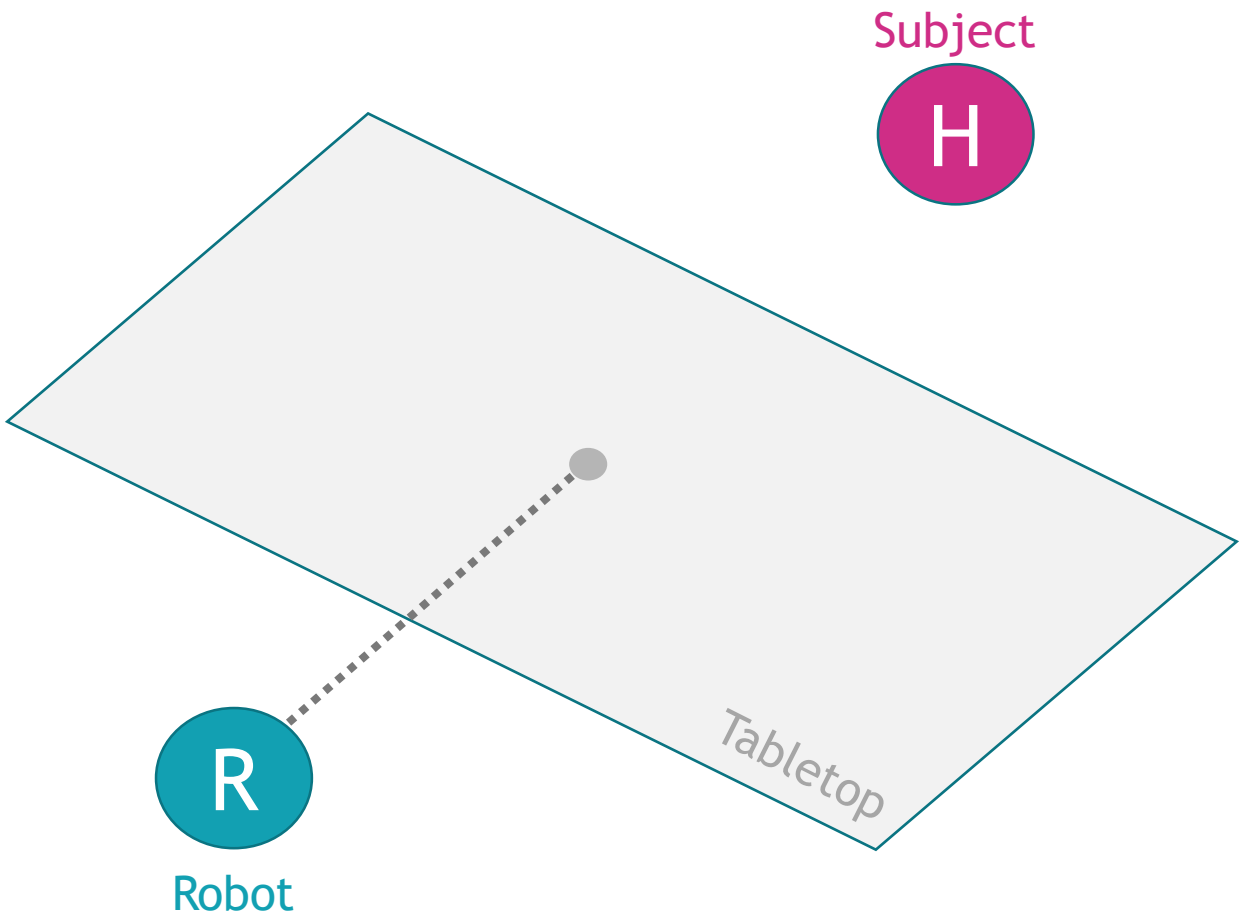
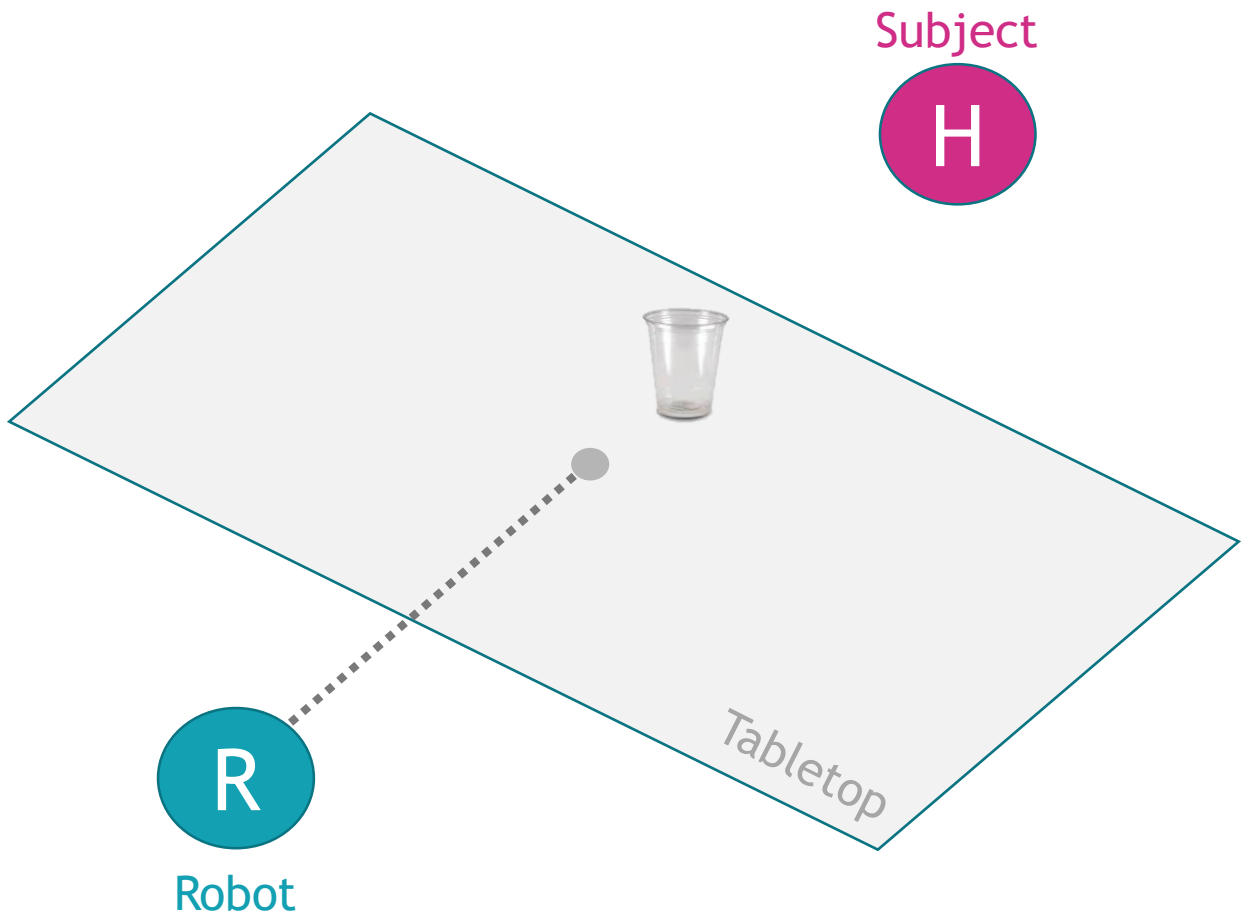
The setup

*The robot should be located so that the tabletop centre is at 40%-50% of the robot reachability



*Initial cup location at a pre-define location

The setup



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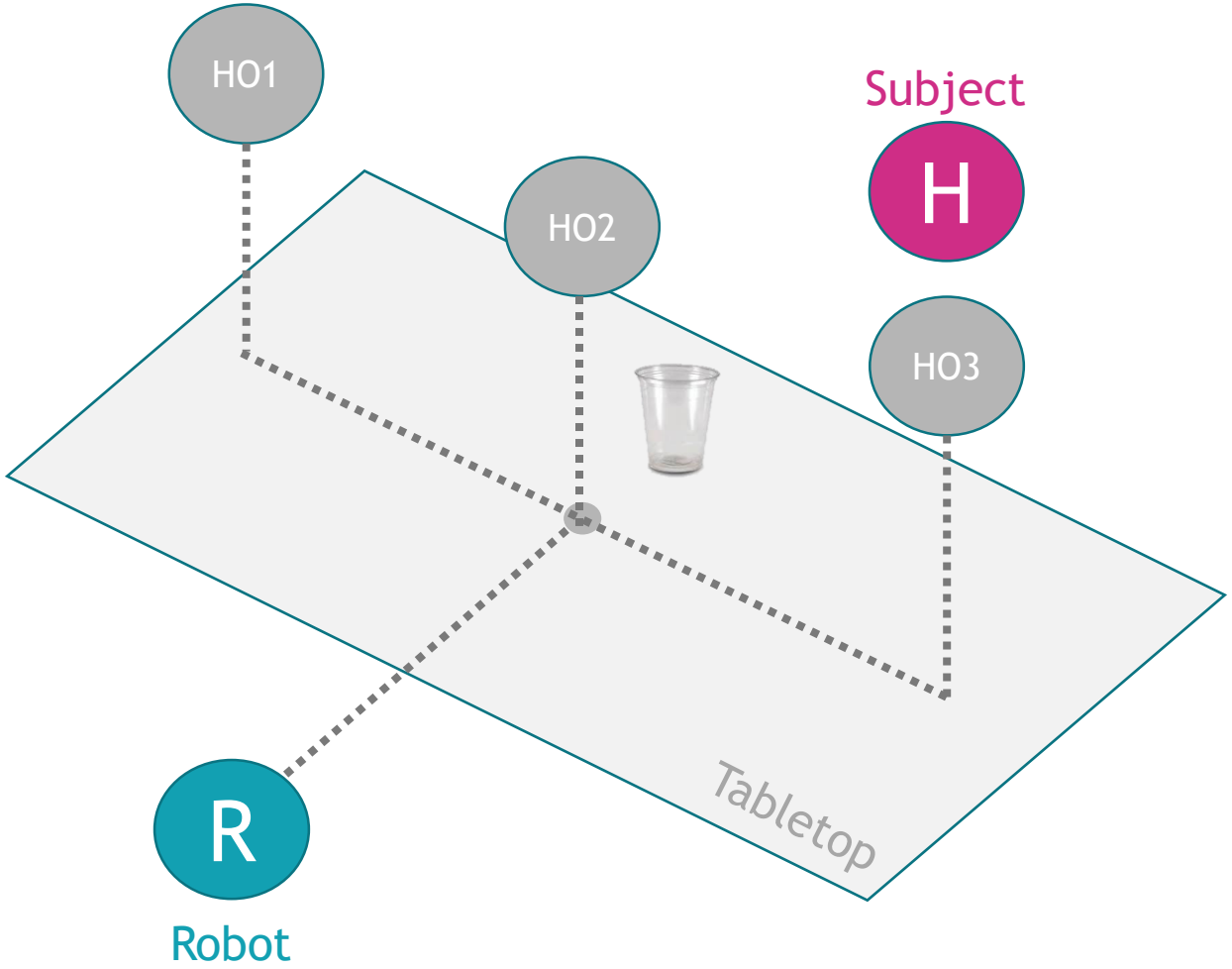
The setup

HOx Handover location x



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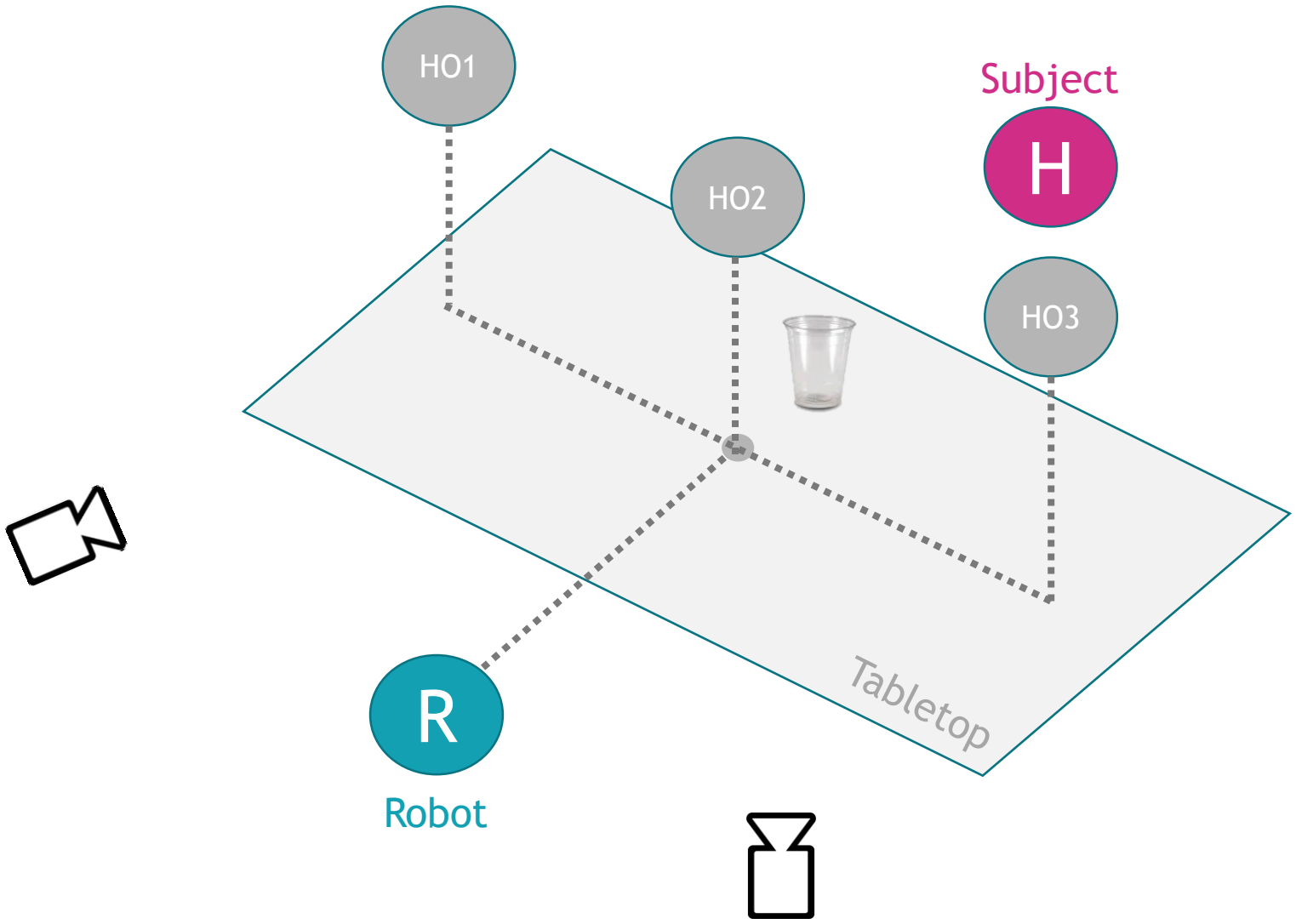
The setup

Sensing:
- up to two cameras
- [optional] force sensors
- [optional] tactile sensors
- [optional] proximity sensors



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The objects

	Cup 1	Cup 2	Cup 3	Cup 4
				
Deformability	High	Medium	Medium	None
Transparency	Medium	Low	High	High

Grasp types

	Cup 1	Cup 2	Cup 3	Cup 4
Grasp 1				
Grasp 2				
Grasp 3				

The CORSMAL benchmark

Objects: 4 cups with different transparencies and deformabilities

Filling: empty or 90% (rice)

Human subjects: 4

Human grasp types: bottom of cup, top of cup, natural (i.e. unconstrained)

Handover locations: in front, front-left, or front-right of robot

Total unique configurations: 4 x 2 x 4 x 3 x 3 = 288

Benchmark for Human-to-Robot Handovers of Unseen Containers with Unknown Filling
Sanchez-Matilla, Chatzilygeroudis, Modas, Ferreira Duarte, Xompero, Frossard, Billard, Cavallaro
IEEE Robotics and Automation Letters (RA-L), vol. 5, no. 2, Apr. 2020

Evaluation scores

Vision scores	Robotic scores	Global scores
Object dimensions Object fullness Object mass	Human-hand pose End-effector pose Object mass	Delivery location Residual filling Manoeuvring time

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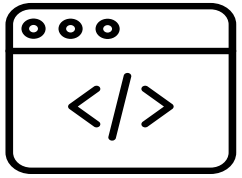
Benchmark: resources

http://corsmal.eecs.qmul.ac.uk/benchmark.html



https://github.com/CORSMAL/Benchmark

The task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CORSMAL Containers dataset

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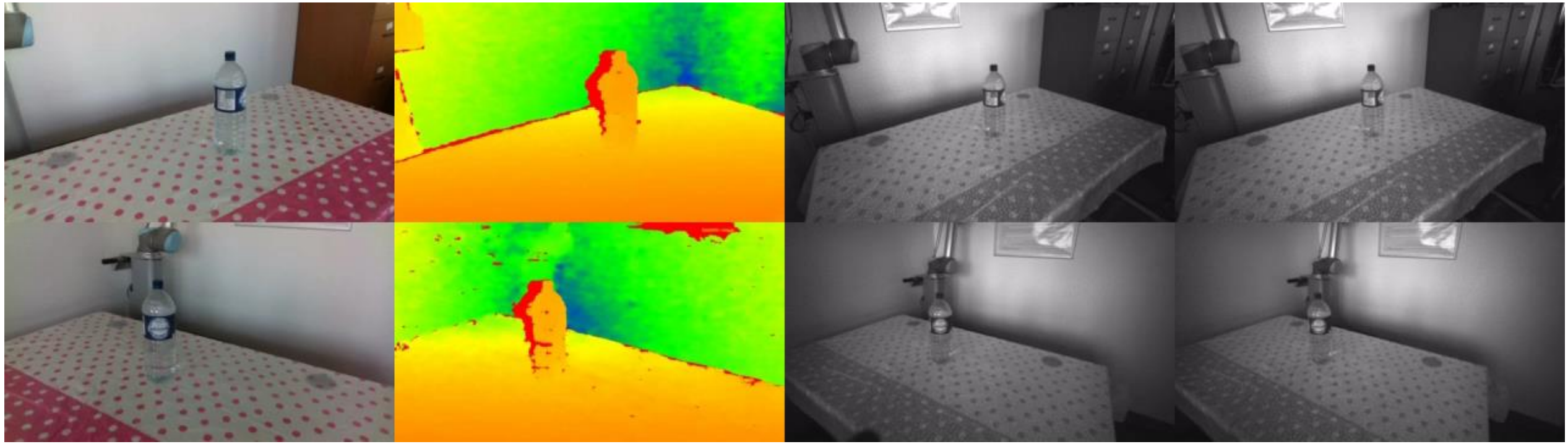
CORSMAL Containers dataset

- Data: RGB, depth, stereo infrared
- Containers: cups, drinking glasses, bottles
- Varying physical properties: material, texture, transparency, shape



CORSMAL Containers dataset

Objects: 23 containers for liquids with different transparencies, shapes, materials

2 setups:

- office with natural light
- studio-like room with no windows

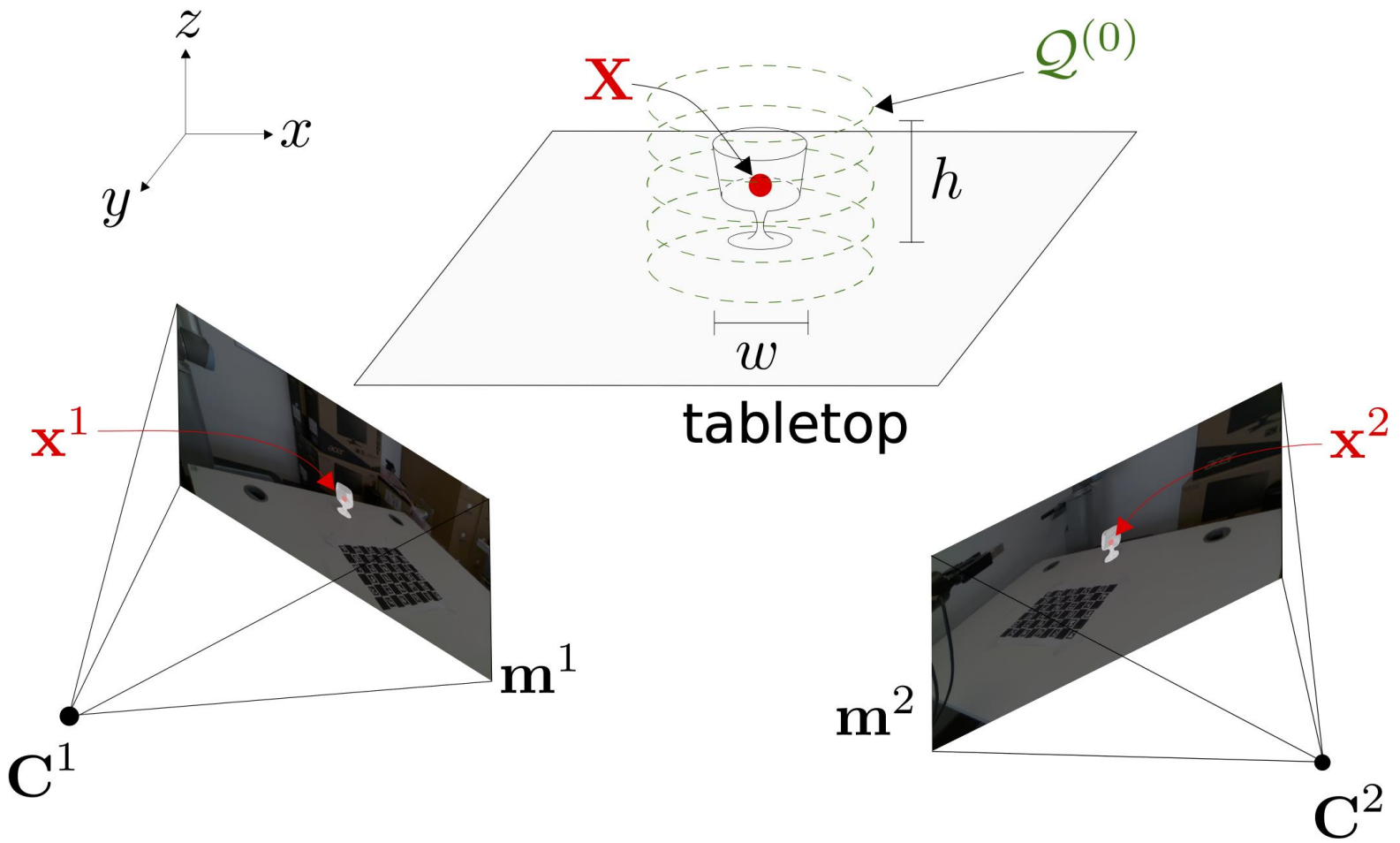
Configurations: (23) objects x (3) background x (3) illuminations = 207

Images: 1,656 (414 RGB + 414 depth + 828 IR)

Calibrated cameras

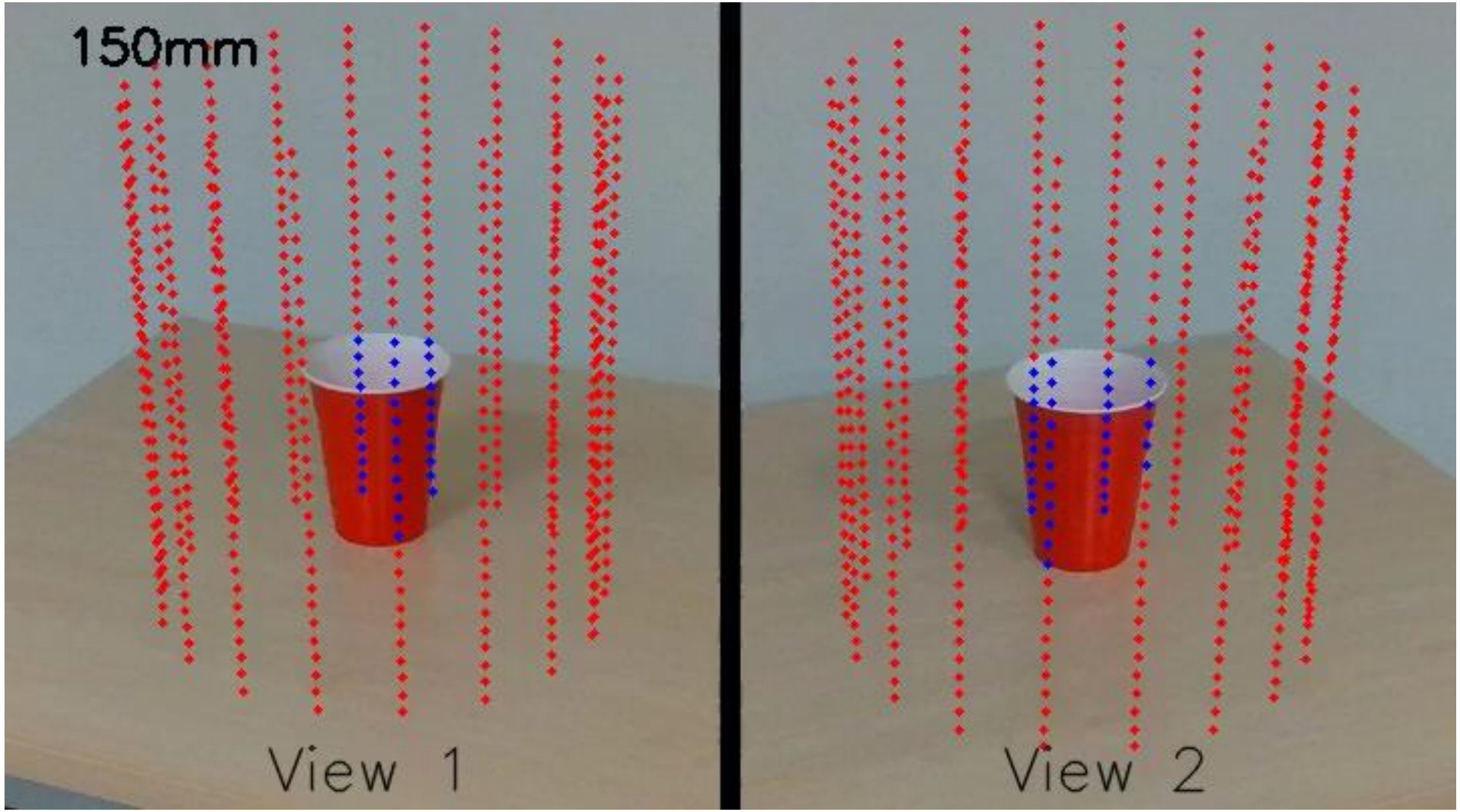
Annotation of the dimensions (width and height) of each object

LoDE: Localisalition and object Dimension Estimator

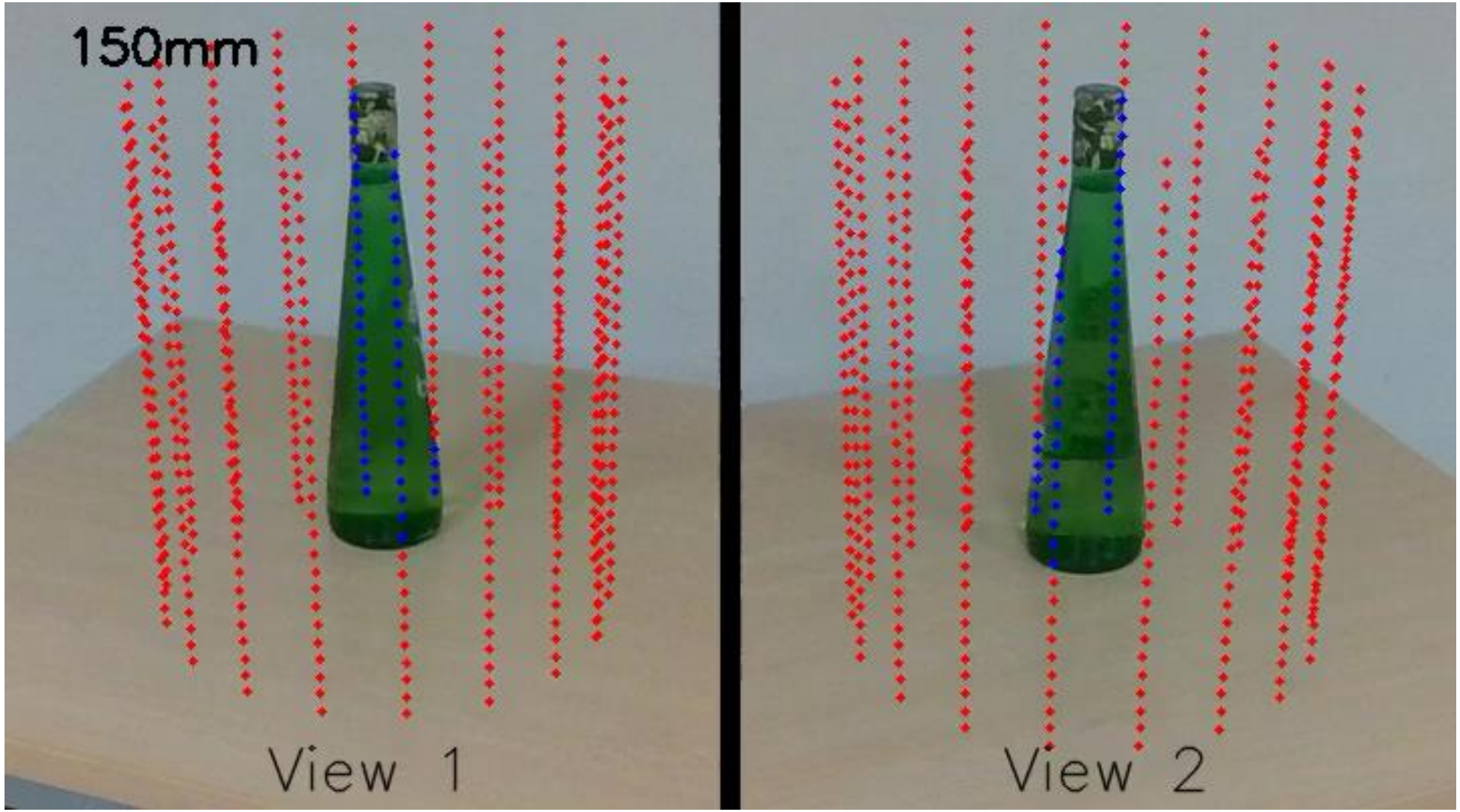


Multi-view shape estimation of transparent containers
Xompero, Sanchez-Matilla, Modas, Frossard, Cavallaro
IEEE ICASSP, May 2020

Iterative multi-view 3D-2D shape fitting



Iterative multi-view 3D-2D shape fitting



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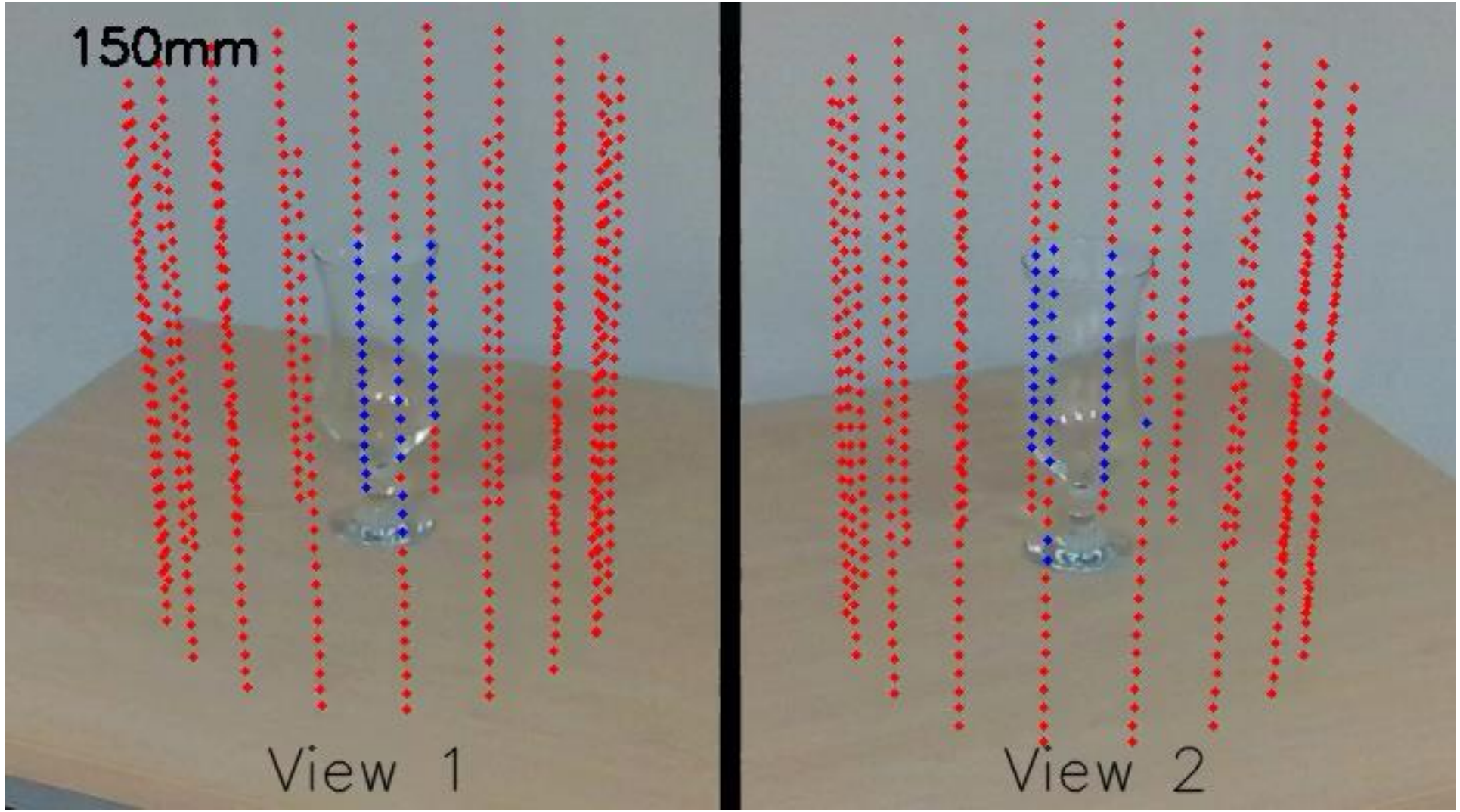

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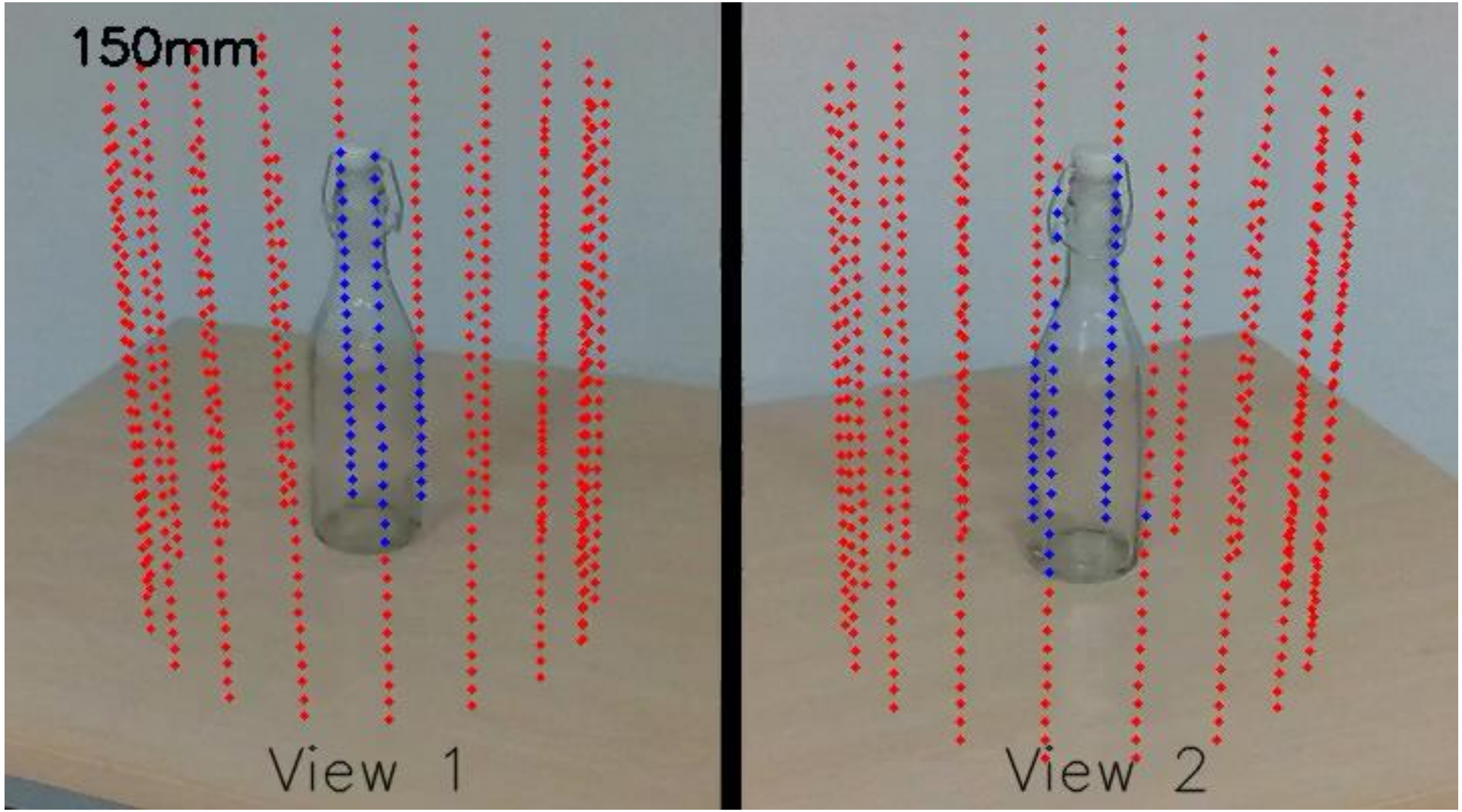
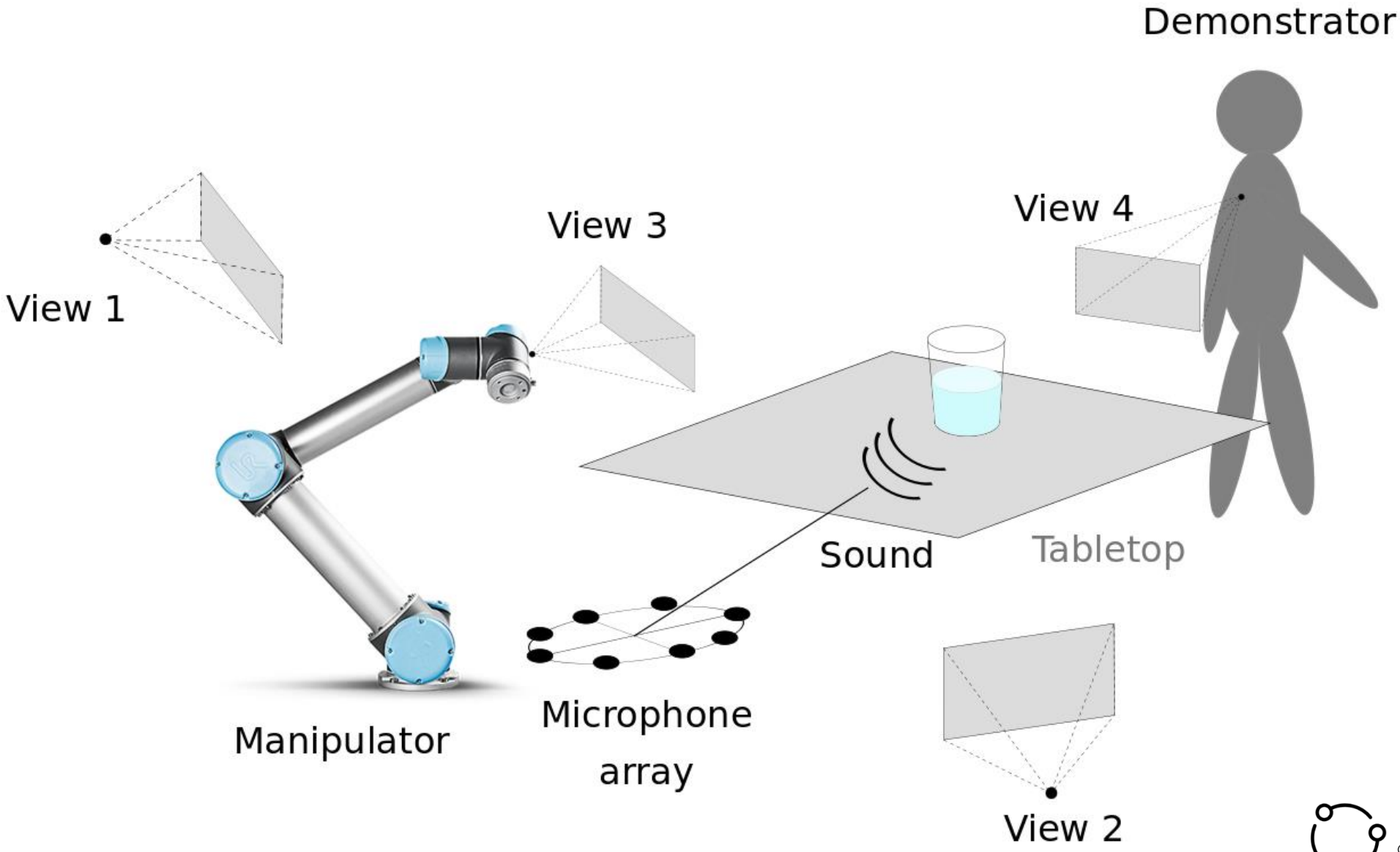


CORSMAL Containers Manipulation dataset



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CORSMAL Containers Manipulation dataset

Objects: 15 containers (5 drinking cups, 5 drinking glasses, 5 food boxes)
Fillings: rice, pasta, water
Fullness: empty, 50%, 90%

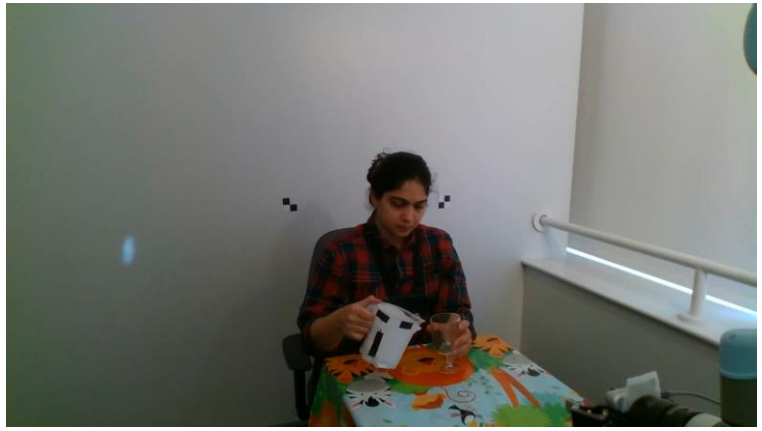
Configurations: 1140
10 cups, glasses x 3 tasks x 2 backgrounds x 2 illuminations x 3 fillings x 2 fullness levels [50%,90%]
5 food boxes x 3 tasks x 2 backgrounds x 2 illuminations x 2 fillings x 2 fullness levels [50%, 90%]
15 empty cups, glasses, food boxes x 3 tasks x 2 backgrounds x 2 illuminations

Sensors

- RGB + Depth + Infrared + Audio + Inertial Measurement Units
- calibrated and synchronised

Annotations
object type, filling type, fullness level, container capacity, mass of container, mass of filling

CORSMAL Containers Manipulation dataset



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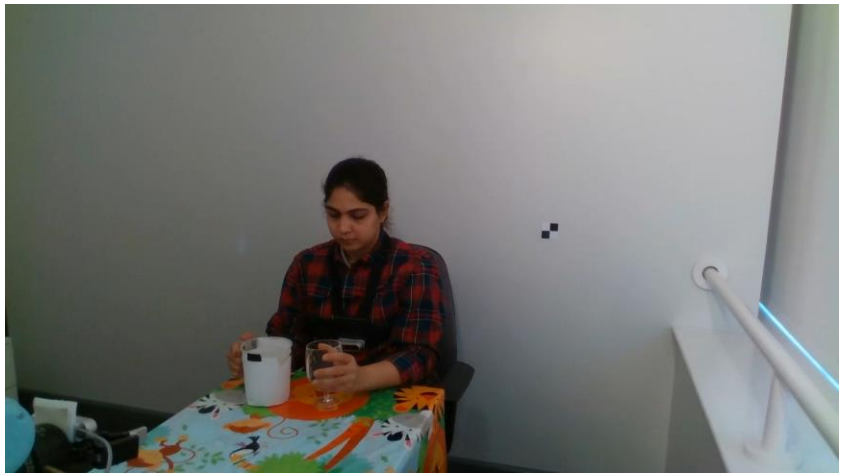
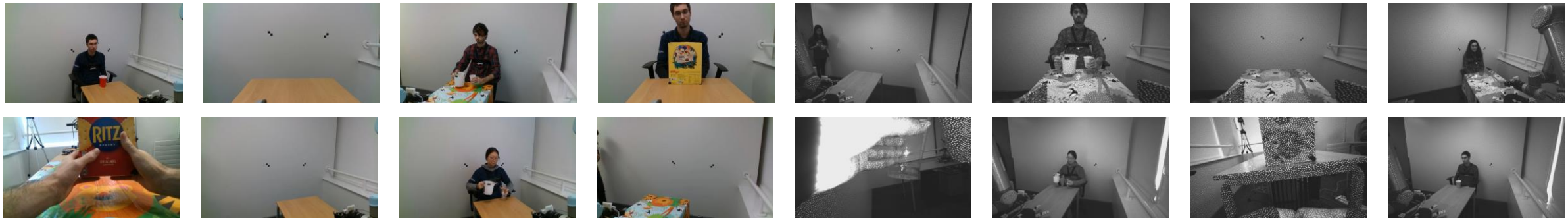
Audio on



Video (RGB, IR, depth) + audio + inertial data with over 1,000 sequences



Summary

Benchmark for Human-to-Robot Handovers
- Protocol
- Baseline code

Datasets
- CORSMAL Containers dataset
- CORSMAL Containers Manipulation dataset

CORSMAL events at
- IEEE Int. Conf. on Multimedia and Expo 2020
- Int. Conf. on Pattern Recognition 2020

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