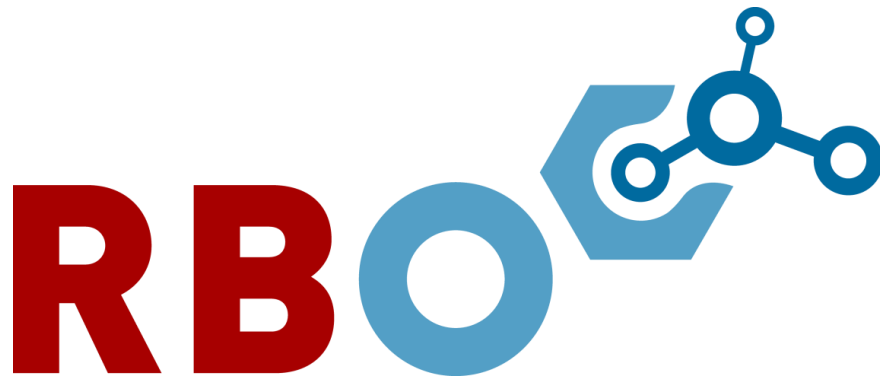




A Critical Review of the State of Affairs in Grasping and Manipulation

Oliver Brock

Robotics and Biology Laboratory

Julia Child (1912 – 2004)



BEYOND force closure

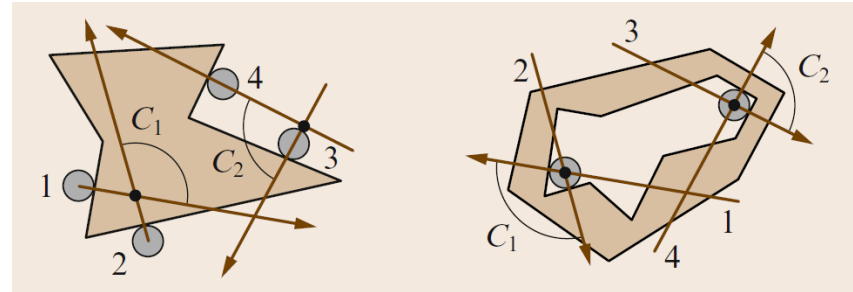
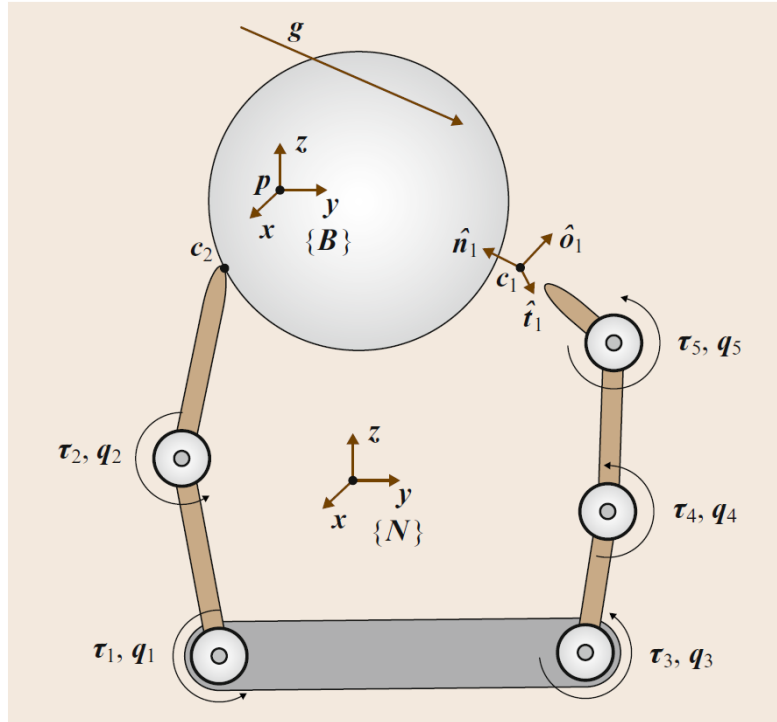
A Scene From
The French Chef - Julia Child

The Potato Show
Season 1, Episode 22, 1963

A Scene From
The French Chef - Julia Child

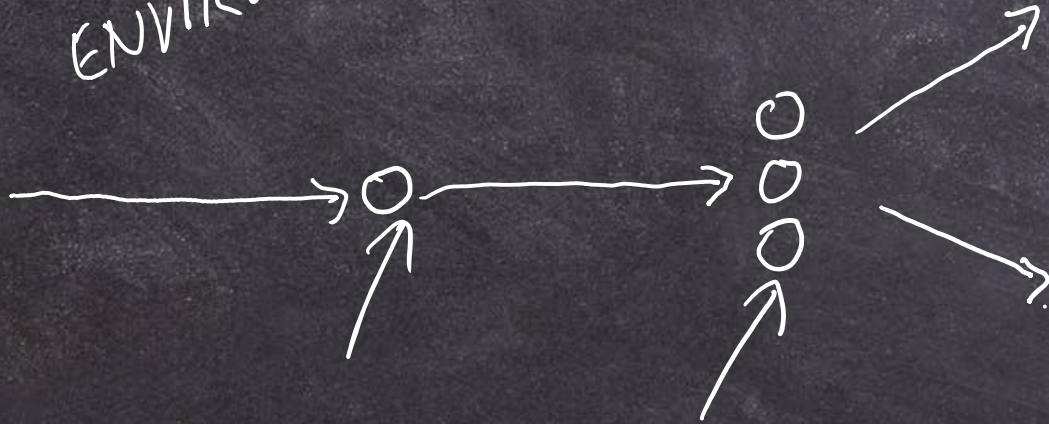
The Potato Show
Season 1, Episode 22, 1963

Where We Started From



From Springer Handbook of Robotics

ENVIRONMENT





insights from HUMANS

3400 Grasping Trials







Steffen Puhlmann



Fabian Heinemann



Marianne Maertens

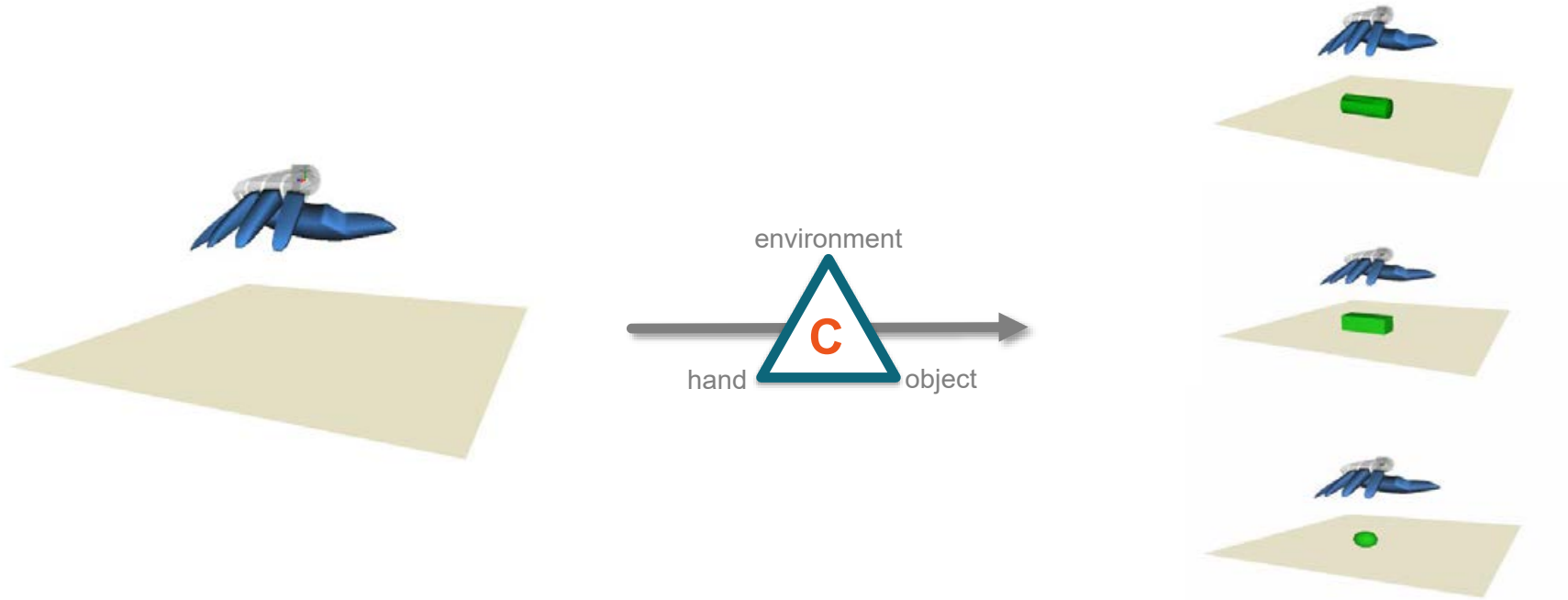
ENVIRONMENTAL constraints



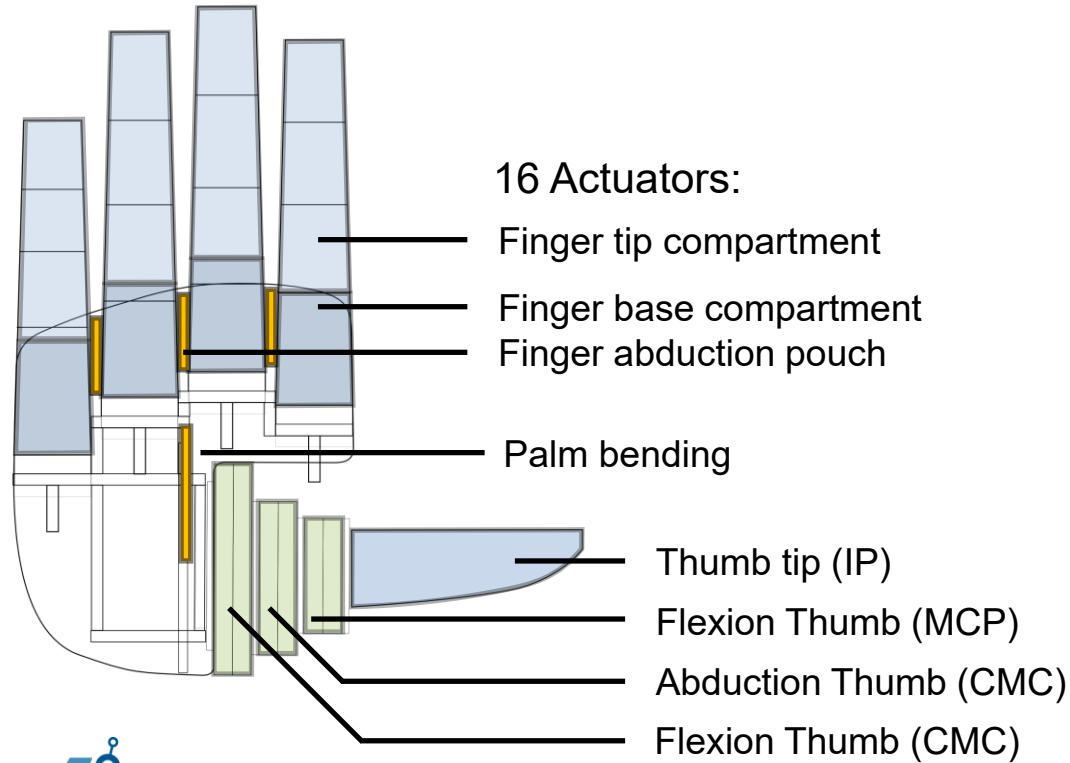
Universal Gripper

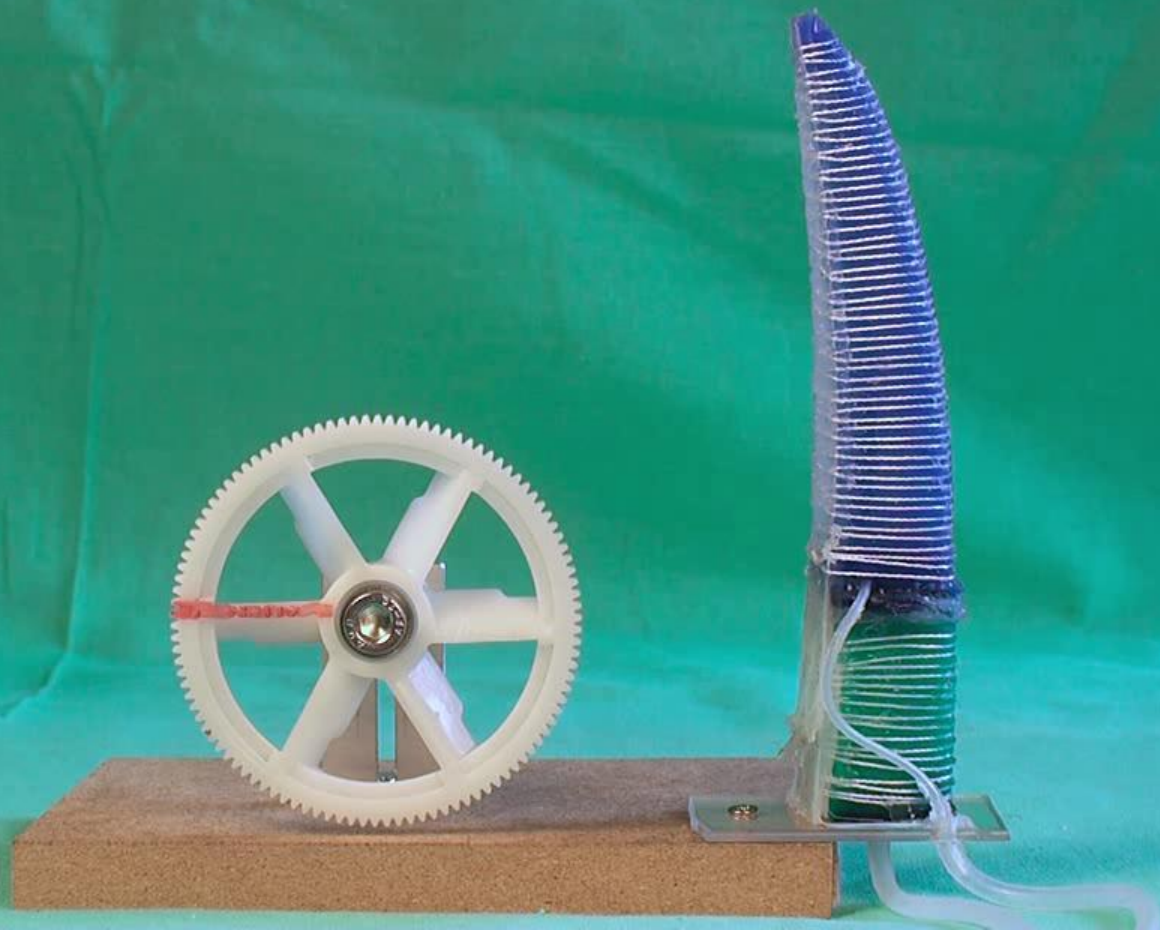
U. Chicago, Cornell, iRobot
May 2010

Morphological Computation



RBO Hand 3

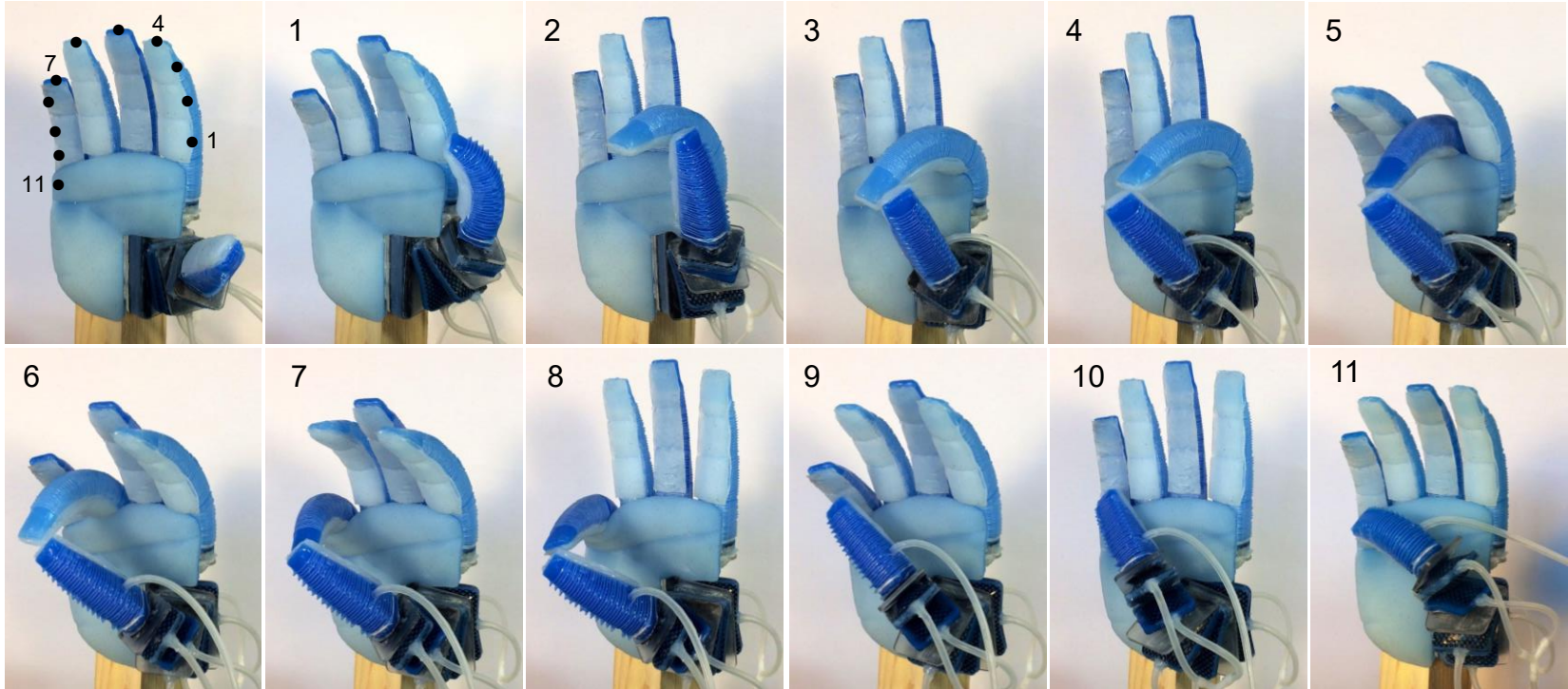


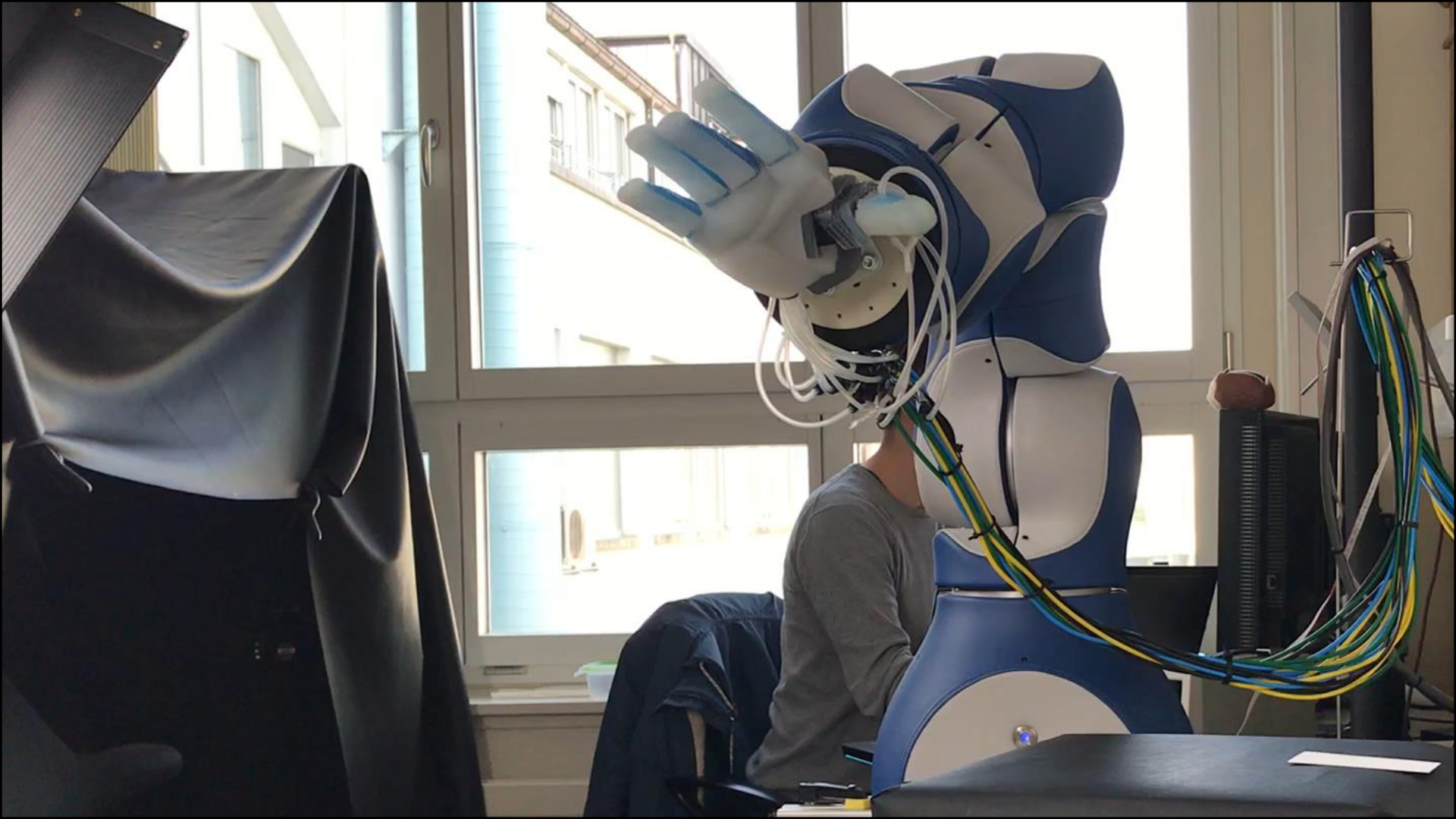






Kapandji Test







1x



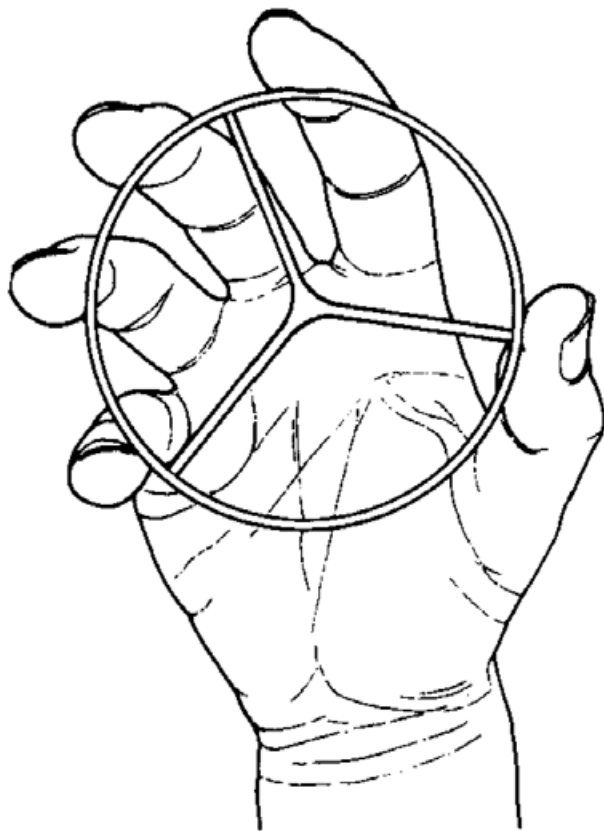


Raphael Deimel
RBO Hand 2



Steffen Puhlmann
RBO Hand 3

IN/HAND manipulation



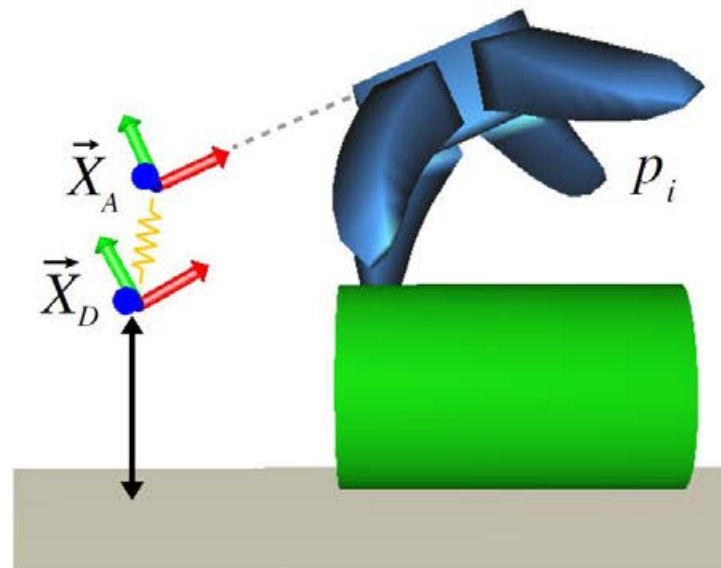
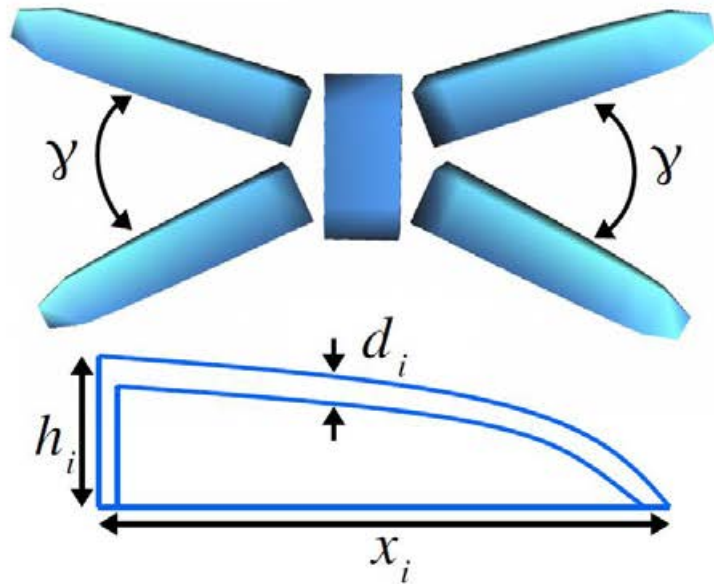


cycles: 0
rotations: 0



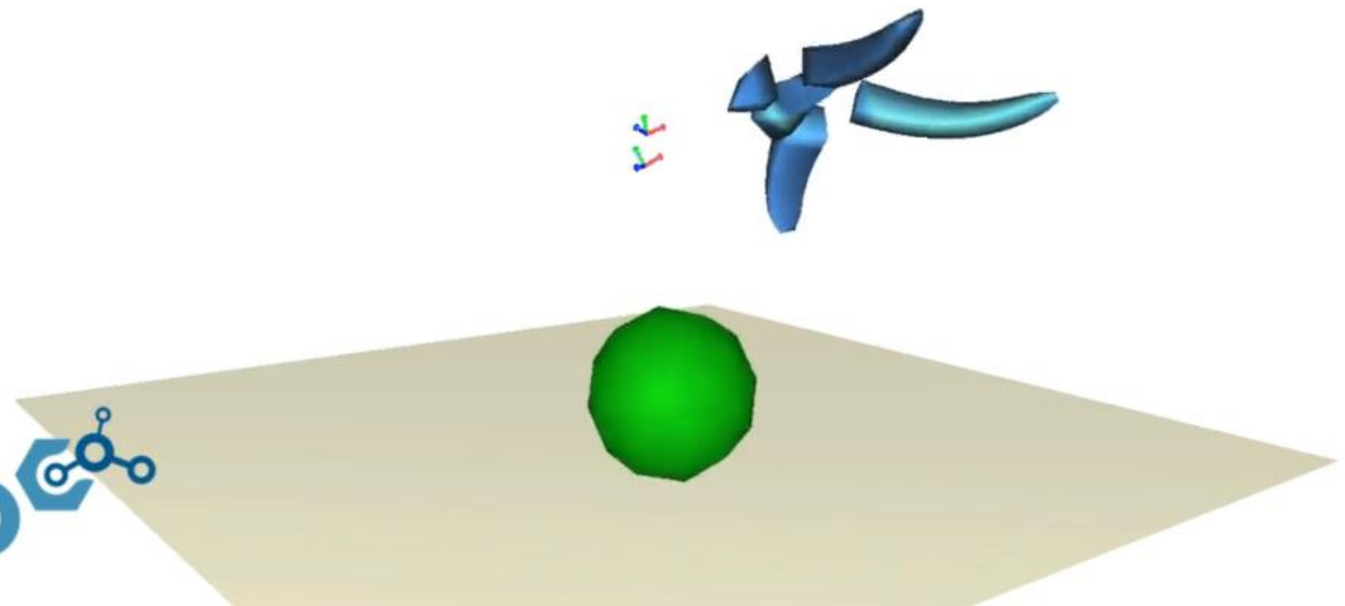


co design



23-Parameter space, intermediate best solutions during optimization

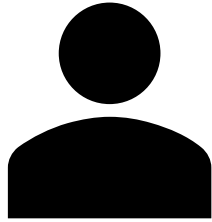
Episode: Seed



Example solutions after co-designing for 128 episodes in 23 dimensions

Compilation of grippers and control strategies
found by co-design in 23 dimensions
after 128 episodes



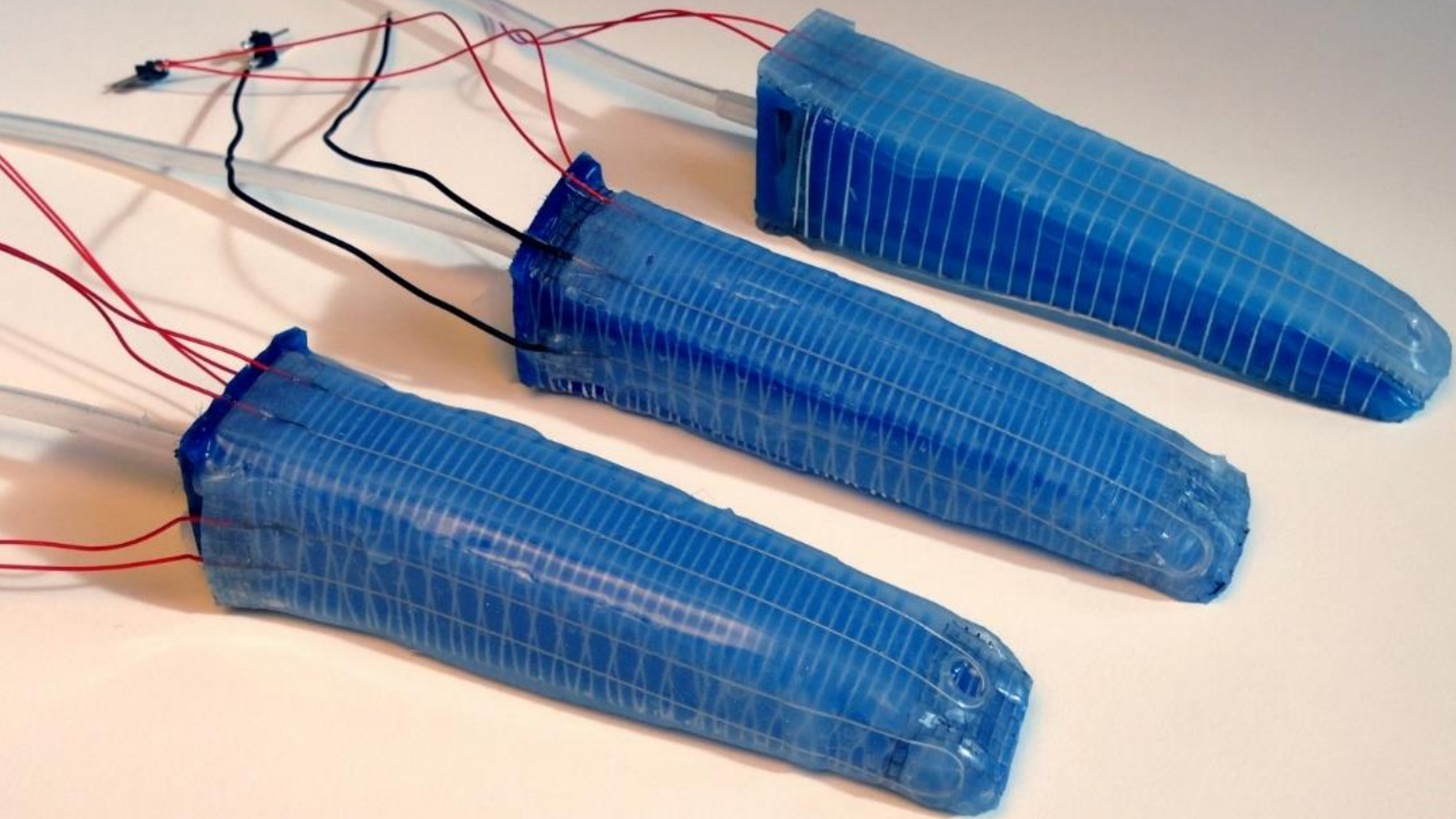


Patrick Irmisch



Raphael Deimel

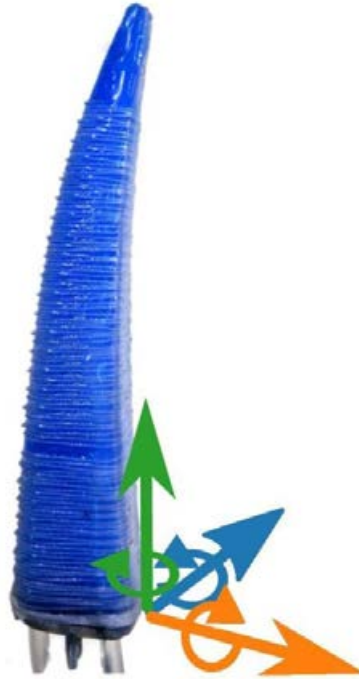
OUTSIDE the box



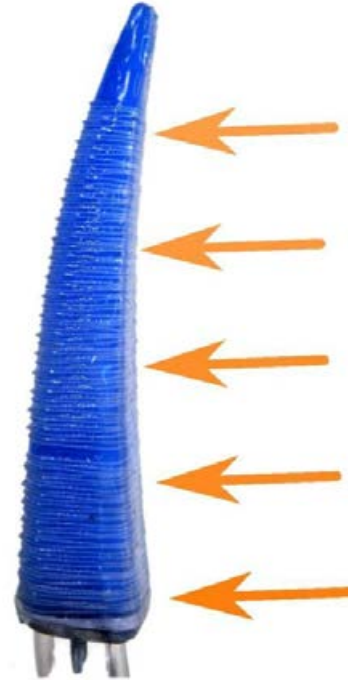
Emulating a Variety of Sensors



3D Orientation



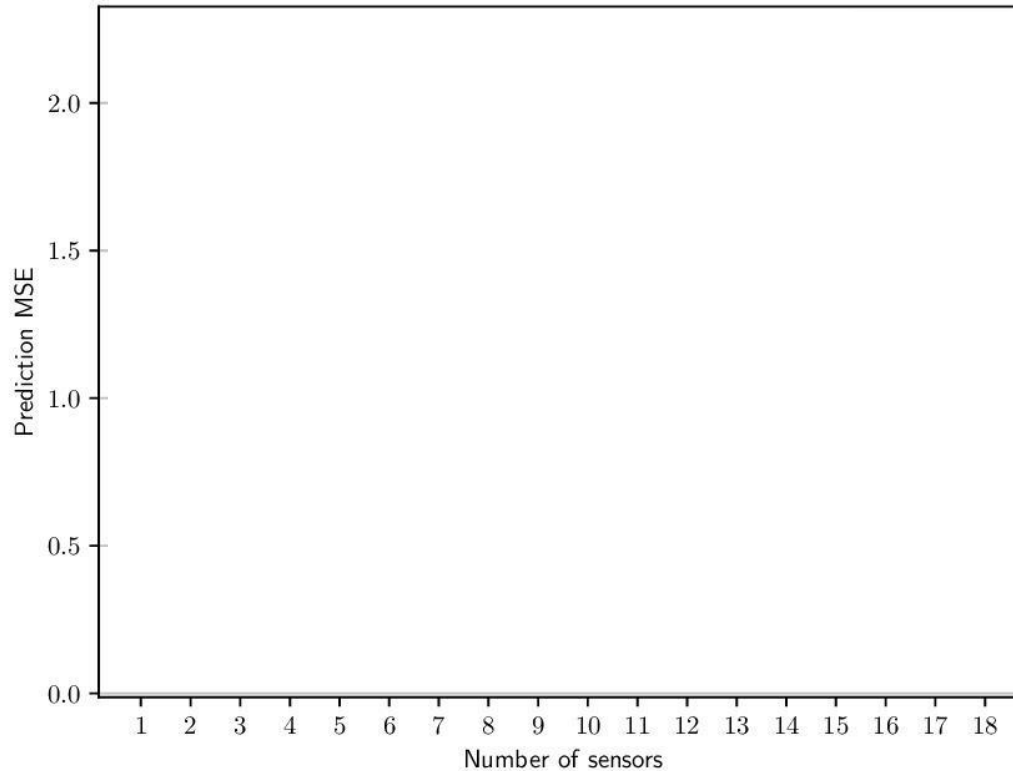
6D Forces and Torques



1D Contact Location

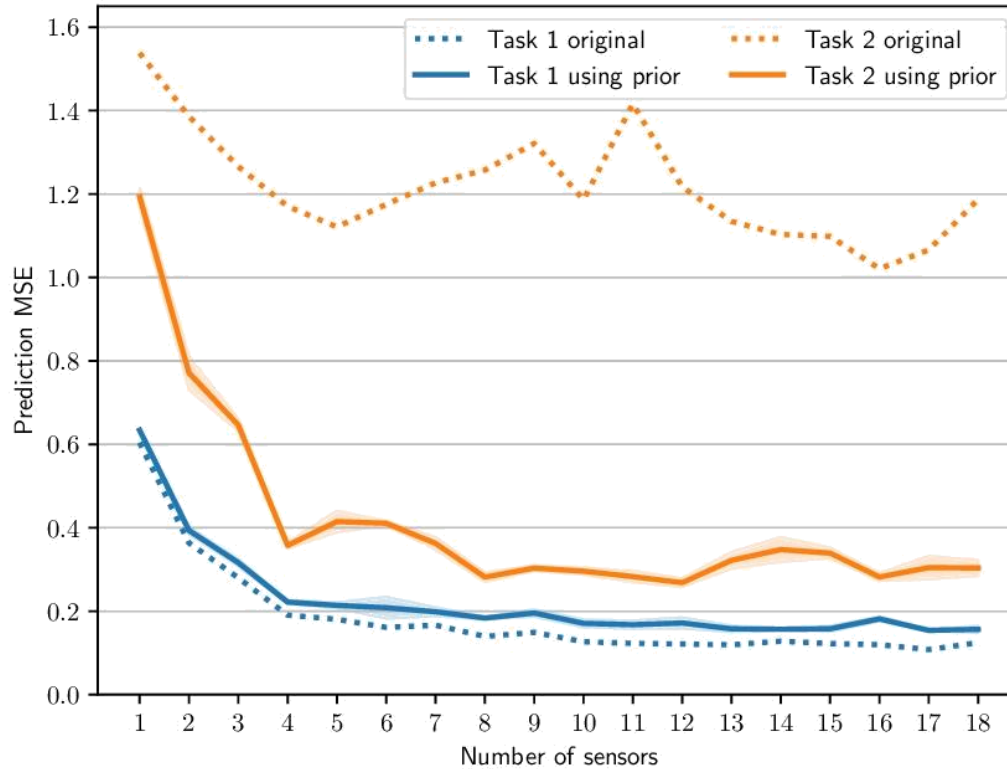
Trained Sensor Model Does Not Transfer

Prediction error of models trained on Task1
(evaluated on test data)



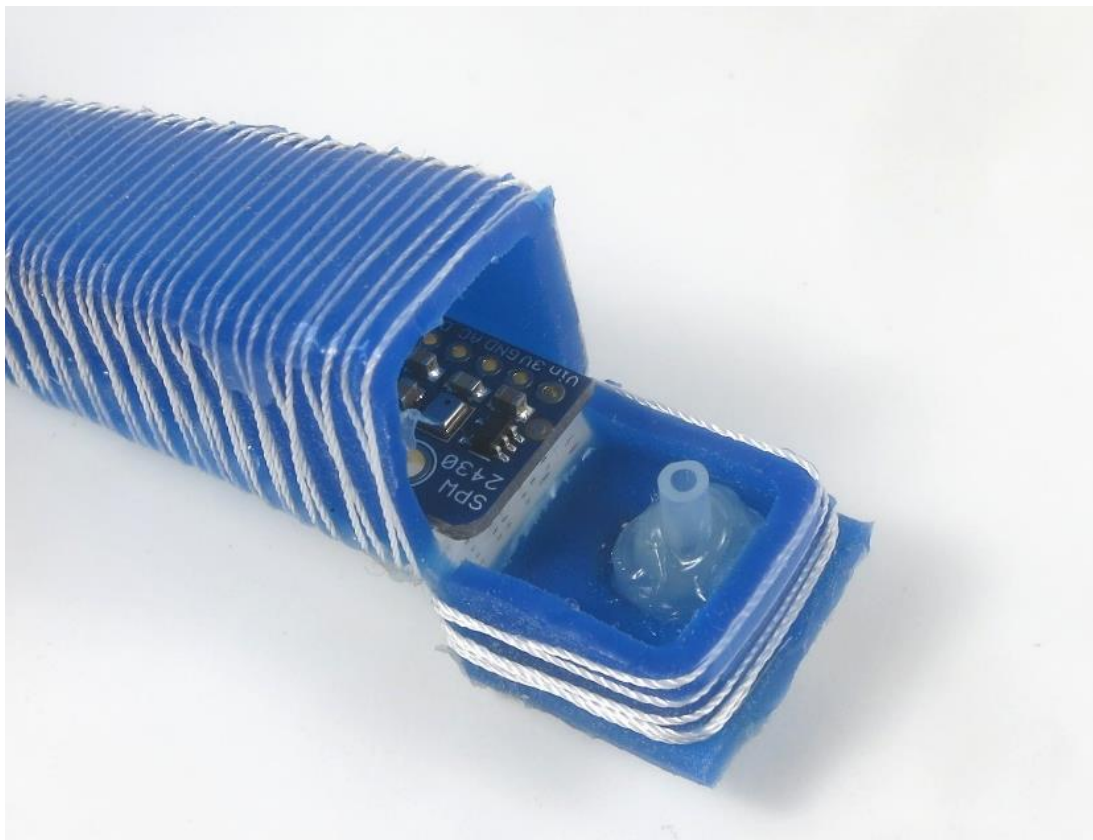
Using Prior Knowledge Aids Sensing

Fixed sensor layout on Task1, extended to Task2
(evaluated on test data)

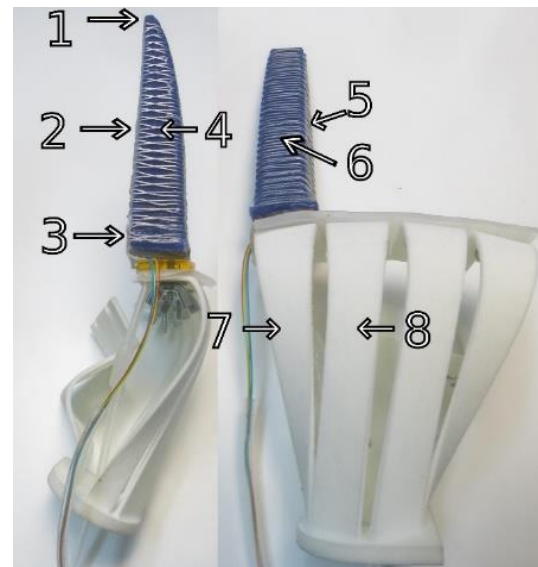
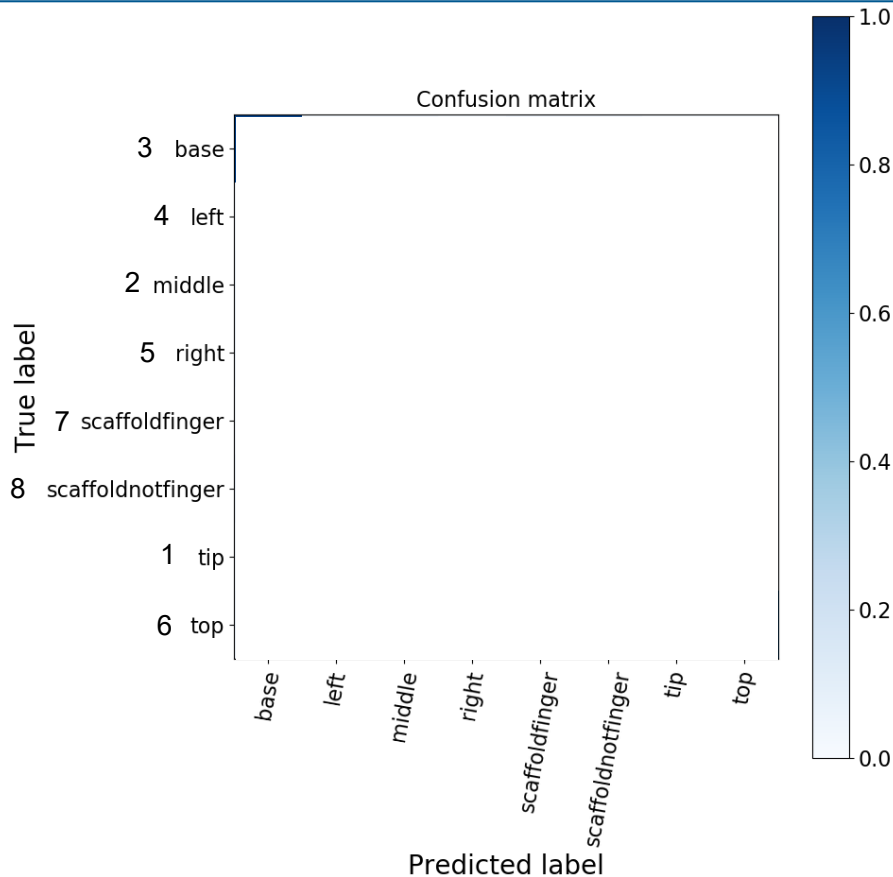




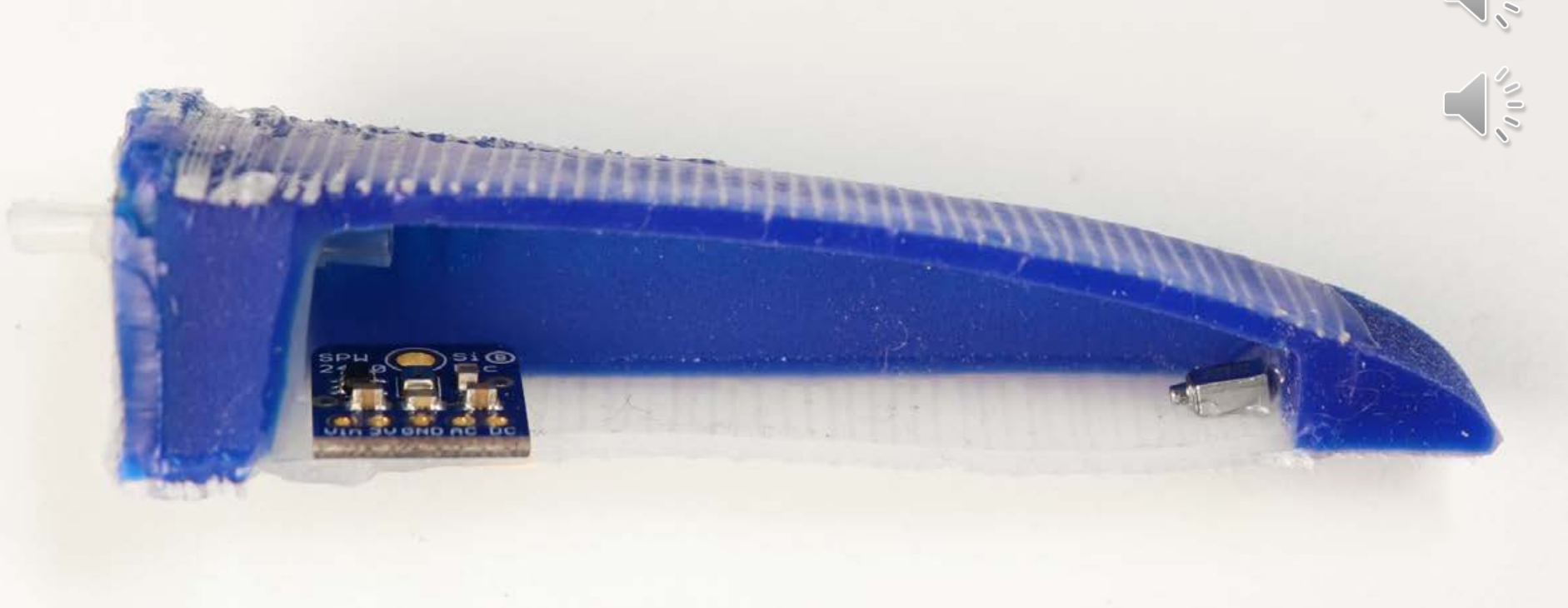
Vincent Wall



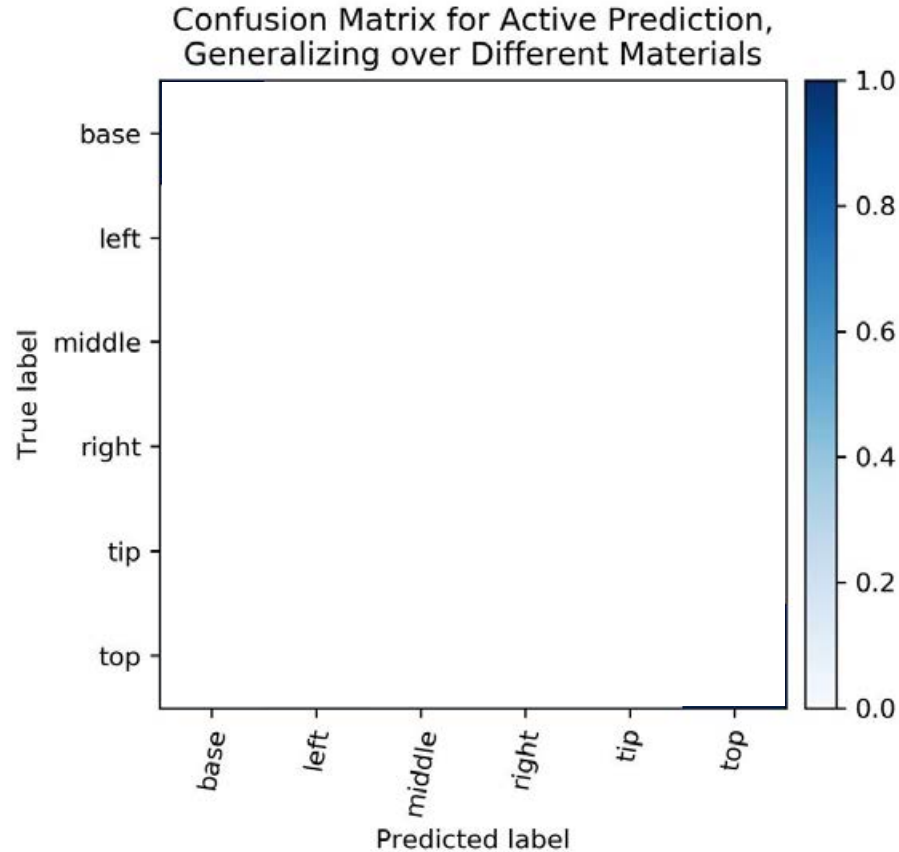
Acoustic Sensing of Contact Location



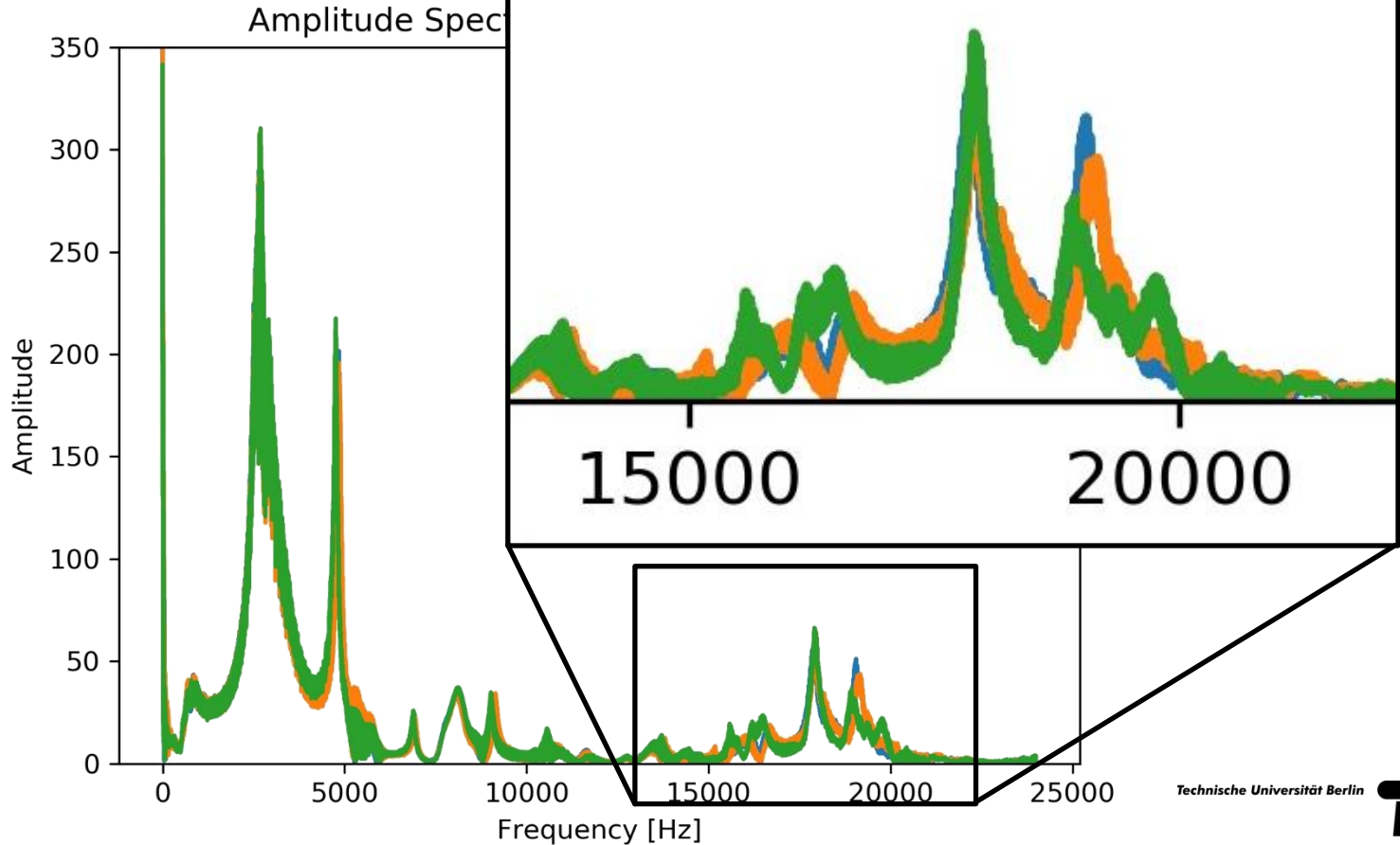
Active Acoustic Sensing



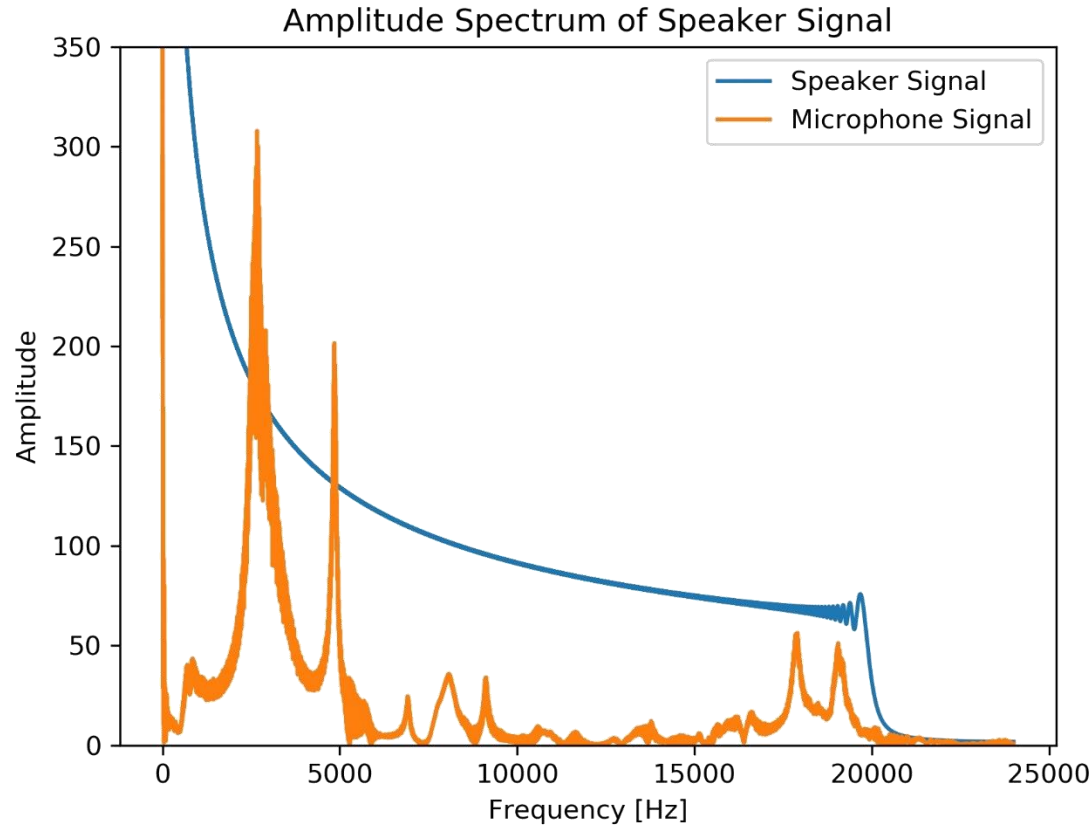
Active Acoustic Sensing While in Contact



Measurements for Tip, I



Morphological Sensing



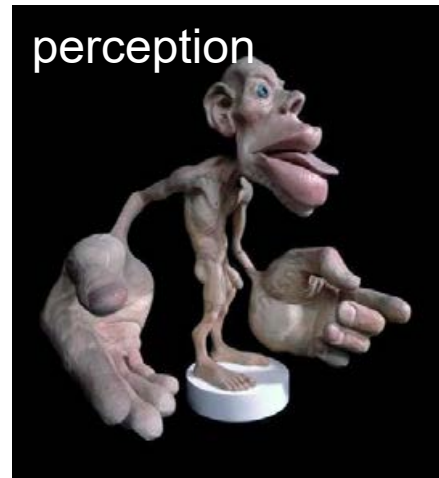


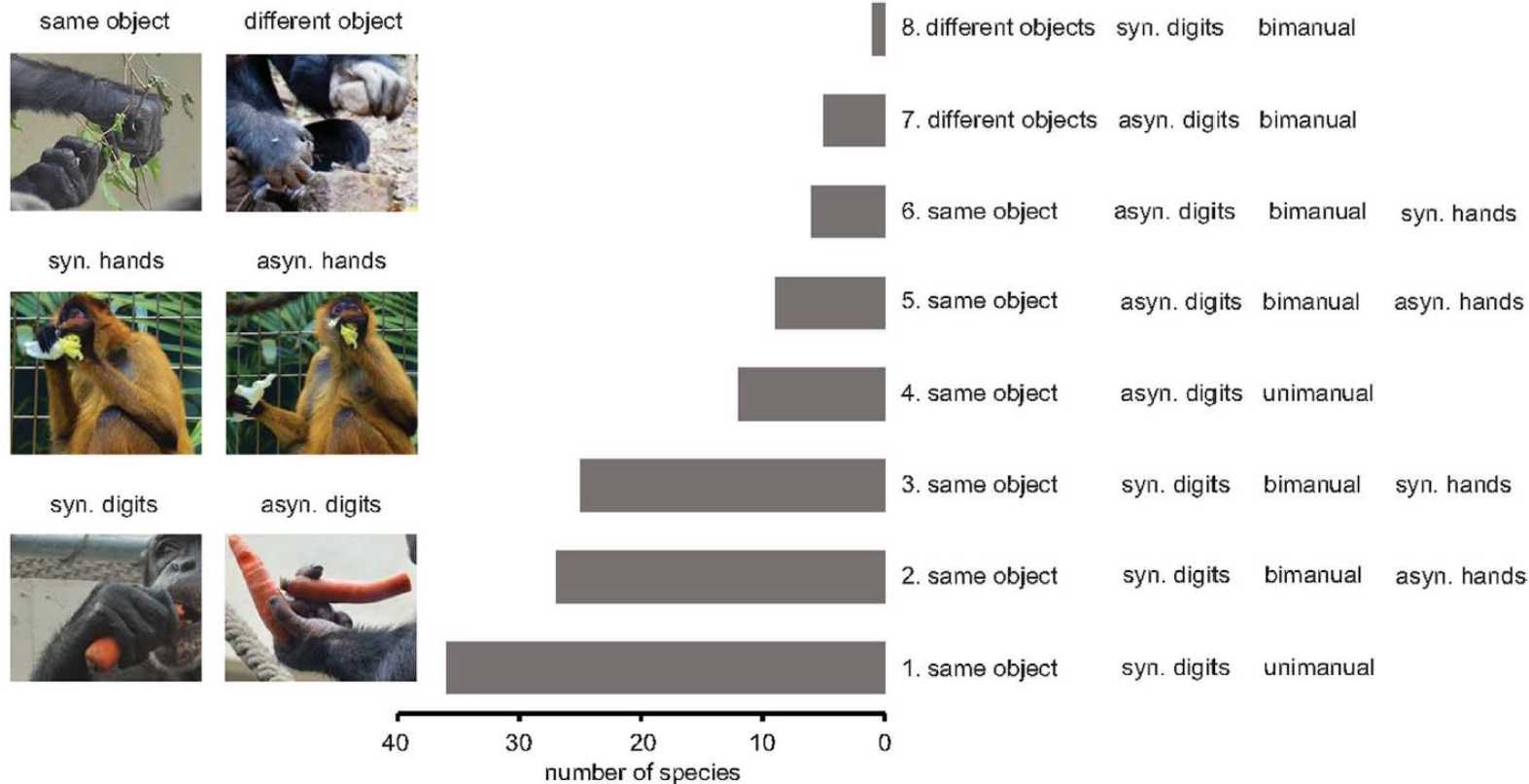
Gabriel Zöller

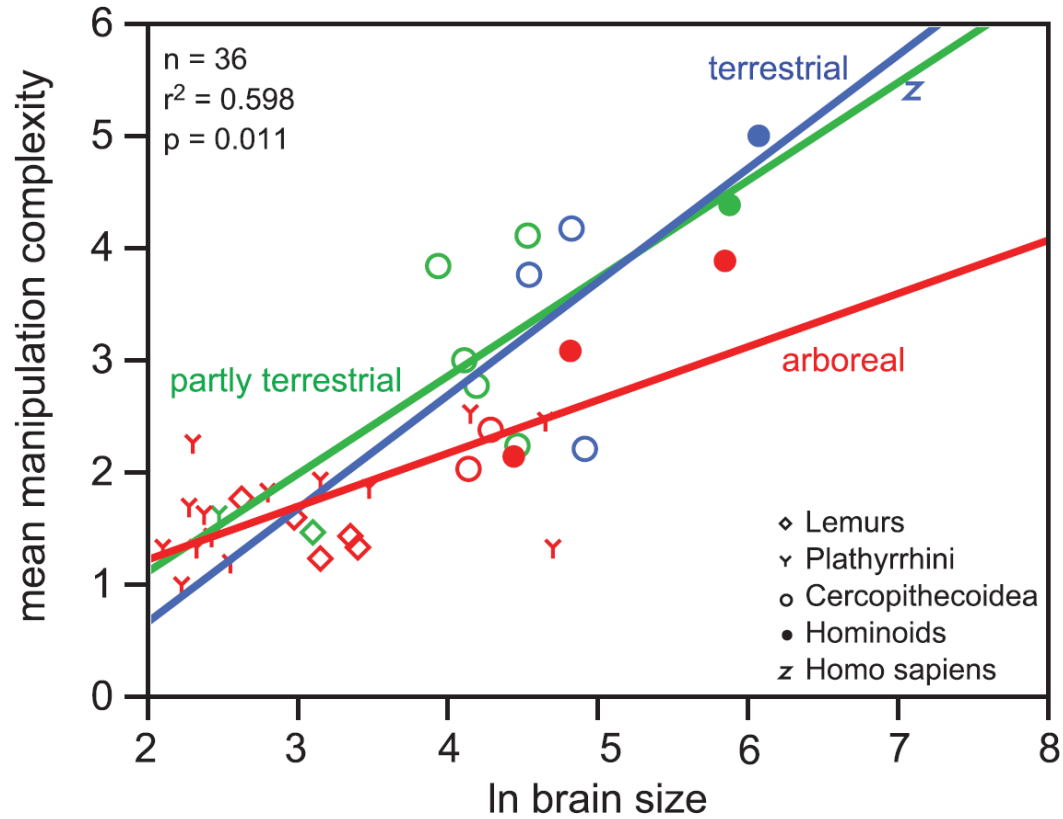


Vincent Wall

NATURE OF the problem







1) HYBRID

2) NEAR-CHAOTIC

3) LOTS OF CONTACT

beyond force closure

insights from humans

environmental constraints

inhand manipulation

codesign

outside the box

nature of the problem

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