Benchmarking Grasping Before It Happens: The Path Is the Goal

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My Theses

- Benchmarking grasping is nearly impossible
- Grasping is a dynamic process, extended over time
- Grasping becomes robust through the exploitation of physical contact between hand/object/environment
- Is the exploitation of physical contact benchmark-able?
- Yes, with morphological computation, but…
Benchmarking: Why and How?

Grasping Pipeline
Do Not Benchmark Robot Hands in the Human Pipeline!

[Image of chop sticks removed to avoid copyright issues]
How to Determine the Bottleneck?

Grasping Pipeline
Benchmarking Hands

from Markus Grebenstein’s PhD Thesis
Benchmarking With Tools
Benchmarking Tasks
Curse of Interaction
Grasp Taxonomies, Quality Metrics

[Cutkosky]
Effect of Actuation Differentiated Through ECs

[Image of grasping hand removed to avoid copyright issues]

actuation -> behavior

actuation -> behavior

C^3

hand

object

environment
Soft Grasping and Soft Manipulation

Little use of constraints = difficult?

Extensive use of constraints = robust?

perception, planning, and control

soft hands

perception, planning, and control
Measure of Morphological Computation [Pfeifer & Bongard 2006]

\[
MC_{MI} = I(W'; W) - I(A; S)
\]

[Zahedi & Ay 2013]
Experiments
First Results with $MC_{MI}$
Benchmarking Morphological Computation

- MC reflects success/effectiveness of ECE
- Explicitly includes control!
- Still depends on task, hand, objects, perception, planning
- Search for the most appropriate measure is on http://soma-project.eu