References for 16-848 for January 29

We started by talking about intrinsic manipulation – manipulating the object within the hand using movements of the fingers.   My favorite reference for this topic is the following:

Elliott JM, Connolly KJ. A classification of manipulative hand movements. Developmental Medicine & Child Neurology. 1984 Jun 1;26(3):283-96.
http://graphics.cs.cmu.edu/nsp/course/16899-s16/papers/Elliott1984.pdf

We then moved on to talking about benchmarking, using this paper as an initial reference:

Quispe, Ana Huamán, Heni Ben Amor, and Henrik I. Christensen. "A Taxonomy of Benchmark Tasks for Robot Manipulation." In Robotics Research, pp. 405-421. Springer, Cham, 2018.
https://www.researchgate.net/profile/Ana_Huaman_Quispe/publication/318726606_A_Taxonomy_of_Benchmark_Tasks_for_Robot_Manipulation/links/599f03830f7e9b892bb930de/A-Taxonomy-of-Benchmark-Tasks-for-Robot-Manipulation.pdf

Human benchmarks (assessment tests) include the Kapandji test:
https://en.wikipedia.org/wiki/Kapandji_score
https://ars.els-cdn.com/content/image/1-s2.0-S0266768103000160-gr6.jpg

.. which has been used as one measure of potential dexterity of a robot or graphical hand design:
https://arxiv.org/pdf/1504.01151.pdf

We also looked at Block and Box test:
https://www.youtube.com/watch?v=jmpNXj5oOo0

Purdue Pegboard test (fine dexterity):
https://www.youtube.com/watch?v=VEjUYXpGzg0

ARAT test (different shaped objects):
https://www.youtube.com/watch?v=f8oiH5OA1Cw

Jebsen Hand Function test (daily living):
https://www.youtube.com/watch?v=ZUzS0ORtz6M
https://www.sralab.org/rehabilitation-measures/jebsen-hand-function-test

Sollerman test (daily living, including bimanual actions):
https://www.youtube.com/watch?v=adaoXVzp3ks
http://www.swisswuff.ch/images/adl/adl-pdf/sollermann1995handfunctiontest.pdf

SHAP test (a more recent test):
https://www.youtube.com/watch?v=5Lby_R0EDeQ
https://www.ottobockus.com/prosthetics/upper-limb-prosthetics/solution-overview/michelangelo-prosthetic-hand/

Note that you can find a simulation setup for the SHAP test here:
http://www.mujoco.org/forum/index.php?resources/categories/models.3/
https://vikashplus.github.io/Publications.html

In robotics, benchmarks often take the form of competitions, such as the DARPA ARM challenge:
https://www.youtube.com/watch?v=jeABMoYJGEU

This paper proposes a metric for comparing robot or prosthetic hand function to that of the human hand.   Human grasps were captured and fingertip motions placed in a 2D space.   Robotic grasps can be mapped to this space.   The metric measures how well the robot grasps cover the space observed in human grasping.
http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6313928

This paper proposes a metric based on the number of locations from which a hand can grasp an object.
http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6094957

This paper introduces the YCB object dataset, designed to at least standardize the object set that we use for benchmarking.   I have one of these sets in my office.
http://www.ycbbenchmarks.com/object-set/

The National Institute of Standards and Technology is making a strong effort to establish a variety of benchmarks for evaluating robot hands, and their current benchmark set can be found here:
https://www.nist.gov/news-events/events/2016/08/robotic-hand-technologies-and-performance-benchmarking

https://www.nist.gov/programs-projects/performance-metrics-and-benchmarks-advance-state-robotic-grasping