

Supplementary Material

S1. Links to external resources

The uncut video of the extended pick and place operation (section 2.4.2) can be found [here](#). All the code used to operate the ADAPT Hand can be found [here](#). The CAD model of the ADAPT Hand can be found [here](#). All data collected from the experiments alongside any other questions should be forwarded to the corresponding author.



Figure S1. The ADAPT Hand showing all 33 grasp taxonomies and the 10 Kapandji score posture.

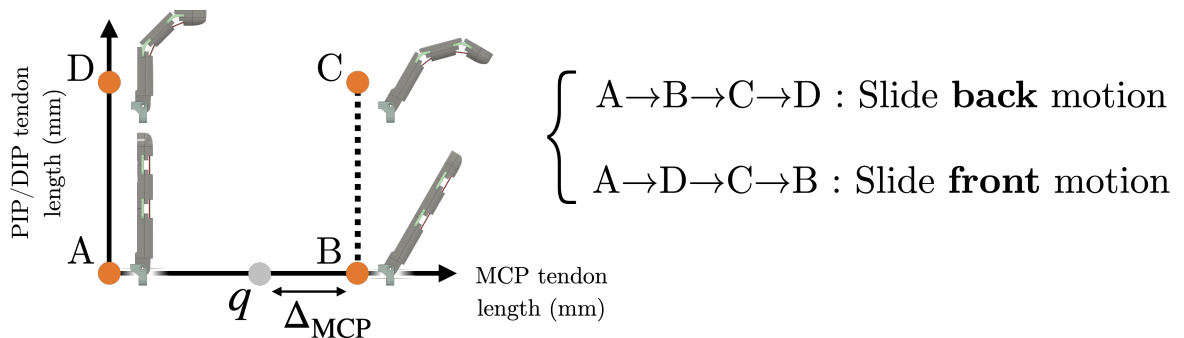


Figure S2. Visual representation of the tendon actuation space for the flexion-extension motion of a single finger. The axis show the two independent motion control for the finger. In the sliding experiment, the “Slide back” and “Slide front” motions are developed by moving between the four waypoints in a clockwise or counterclockwise fashion. Δ_{MCP} shows the how much the MCP joint is overdriven.

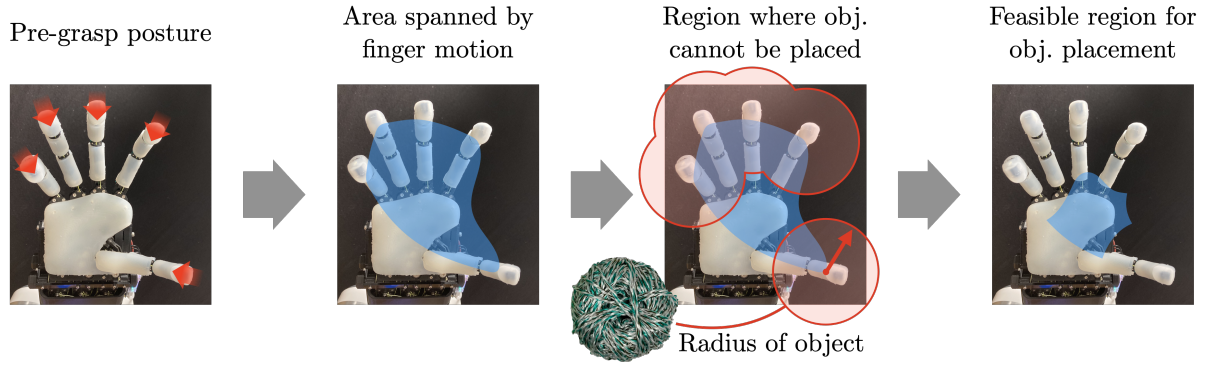


Figure S3. The flowchart used to estimate the geometrical limits for open-loop grasping an object. First, the directions of the finger/thumb motion for the grasp is noted. Then, an approximate area spanned by the finger/thumb in this grasping motion is obtained. Assuming the center of mass of the object must lie within the fingertips, an area where the object would collide with the fingertips is found. Finally, subtracting the two areas gives the estimated geometrical limits of where the center of mass of the object can be placed.

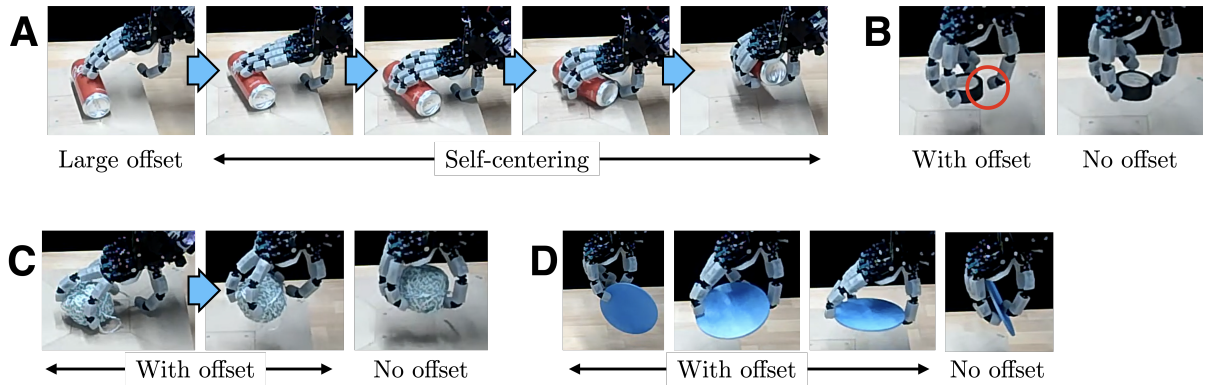


Figure S4. Four examples of the ADAPT Hand grasping objects when an artificial offset is given. A: Even with a large offset, the compliance and the motion of the hand self-centers the coke can to be grasped. B, C, D: Examples where the resultant grasp differs from that of $\Delta_M = 0$.

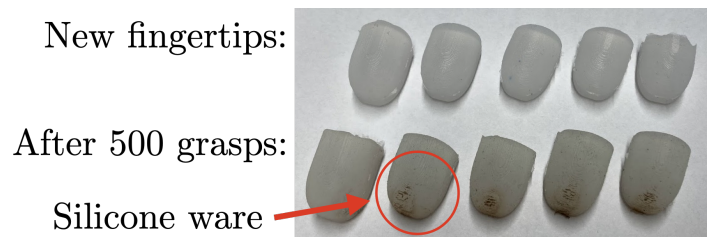


Figure S5. Photograph to show the ware and tare of the silicone fingertips before and after the extended pick and place experiment.

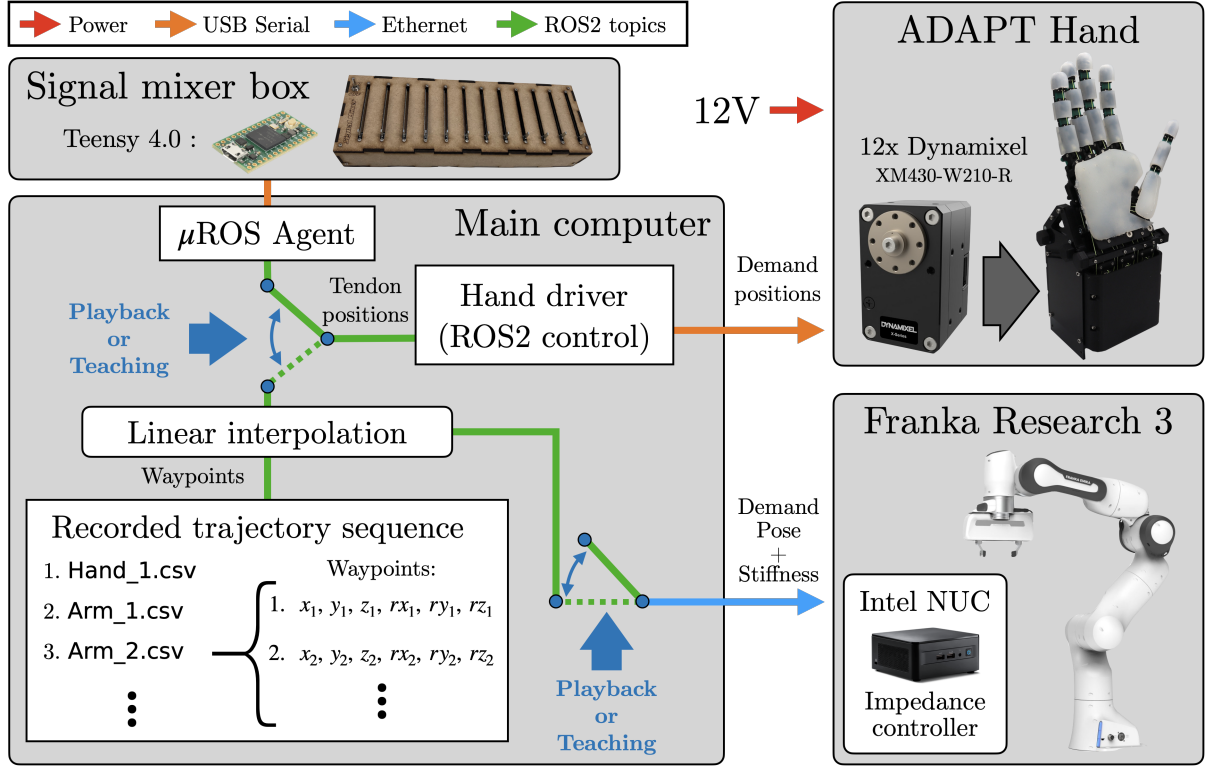


Figure S6. A high level software and system integration diagram used to control the ADAPT Hand. The heart of the control is the teaching and playback system described in section 4.2. When teaching (recording) different motions, the hand is actuated using a signal mixer box where the sliders correspond to demand tendon positions. No control input is given to the arm to be moved freely by hand. In the playback mode, the recorded waypoints (a sequence of csv files for the hand or the arm) will be executed sequentially either to the hand or arm. The full system is developed using ROS2 to interface between microcontrollers (micro-ros), custom processes, ADAPT Hand (ROS2 control driver), and the Franka impedance controller[46].



Figure S7. The measurement of human compliance (force-displacement characteristics) using a UR5 robot arm mounted with a 10kg loadcell. The robot arm is moved in different axis to while the human is instructed to relax.