Grasp, lift, replace task (example of dextrous manipulation)

Task conducted for experimentally determining parameters such as coefficient of friction

5 phases separated by 4 events

assumptions:
- Object is block shaped
- Object location known
- Each finger equipped with two force sensors to measure grasp friction and lift, and a multi-element strain-rate sensor for sensing slip
- Slip is detectable from other vibrations
- Position sensor for fingertip location is also available

When any slip is detected, grasp force is incrementally increased till object is successfully lifted

\[ W = 2M F_g = F_e \Rightarrow \text{weight } W, \text{ friction coefficient } \mu \]

Can be found from forces \( F_g \), \( F_e \)

\[ k = \frac{A F_g}{A x} \] determines stiffness as ratio of excess grasping force to deformation
1. Finger 1 approach before Finger 2
2. At most two attempts for finger alignment permitted
3. At most three attempts to make contact
4. At most two attempts to adjust grip force when slip detected