Towards Natural Human-Swarm Teleoperation Using Hand Synergies

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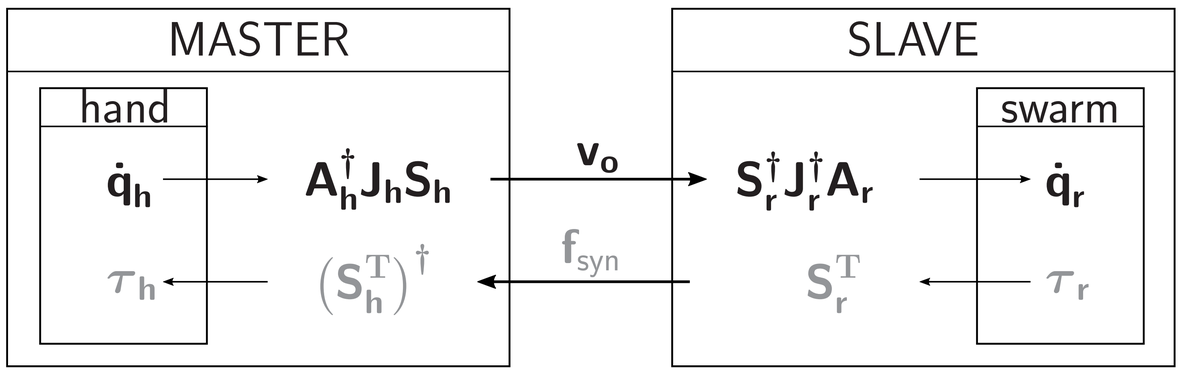
Goal

Development of a **natural** and **intuitive** human-swarm teleoperation scheme extending the concept of **hand-synergies**

Control Scheme



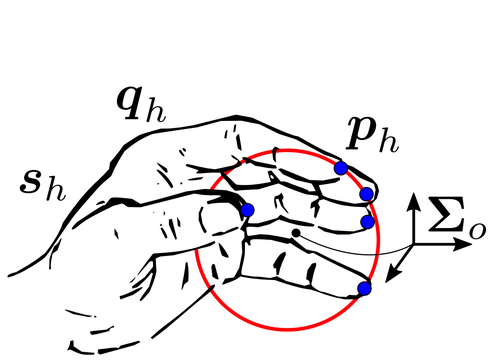
Synergies

- Controlling multiple degrees of freedom with a lower dimensional input

Data $\longrightarrow$ PCA analysis $\longrightarrow$ Low-dimensional input

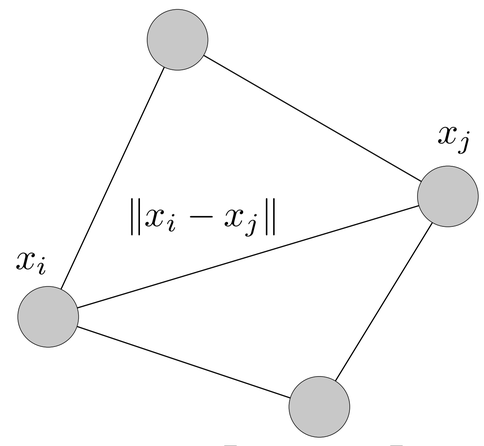
- Robotic swarm is formation-controlled

System Model



$$\dot{q}_h = S_h \dot{z}_h$$
$$\dot{p}_h = J_h \dot{q}_h$$
$$\dot{o}_h = A_h^\dagger \dot{p}_h$$

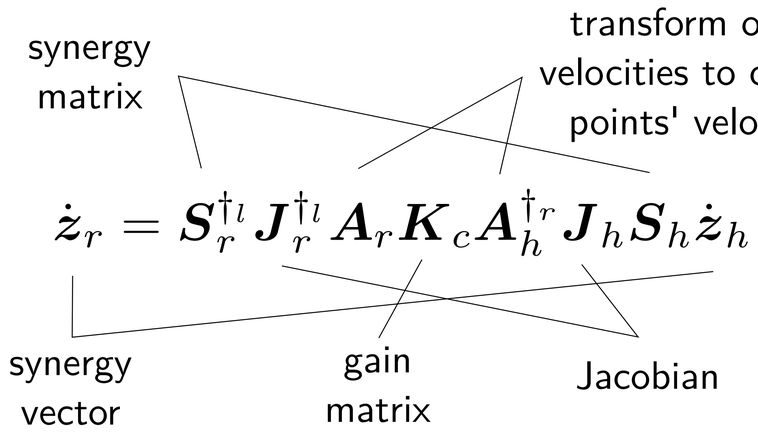
(a) Human hand model



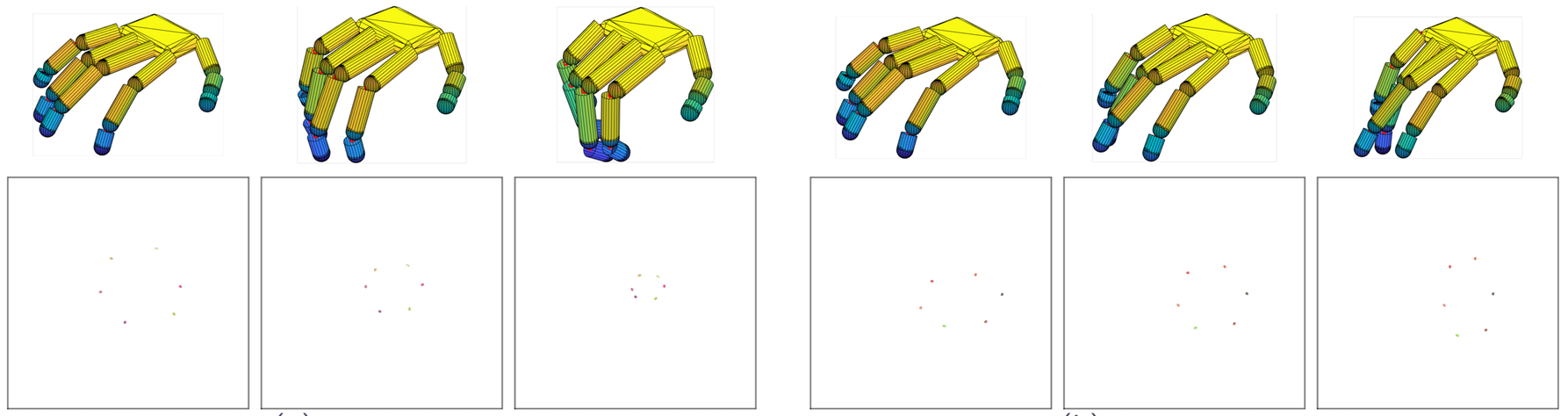
$$q_r = \begin{bmatrix} \vdots \\ \|x_i - x_j\| \\ \vdots \end{bmatrix}$$

(b) Robot swarm model

Synergistic Control



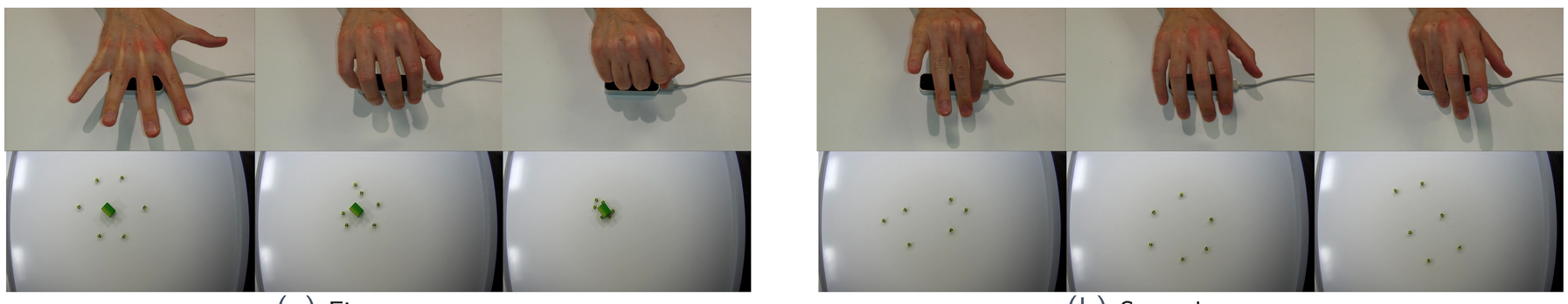
Simulated Experiments



(a) First synergy. (b) Second synergy.

Figure: Snapshots of the simulated environment used to test the proposed teleoperation framework

Experiments on the Robotarium



(a) First synergy. (b) Second synergy.

Figure: Snapshots of the video recorded on the Robotarium on which the proposed teleoperation framework has been validated