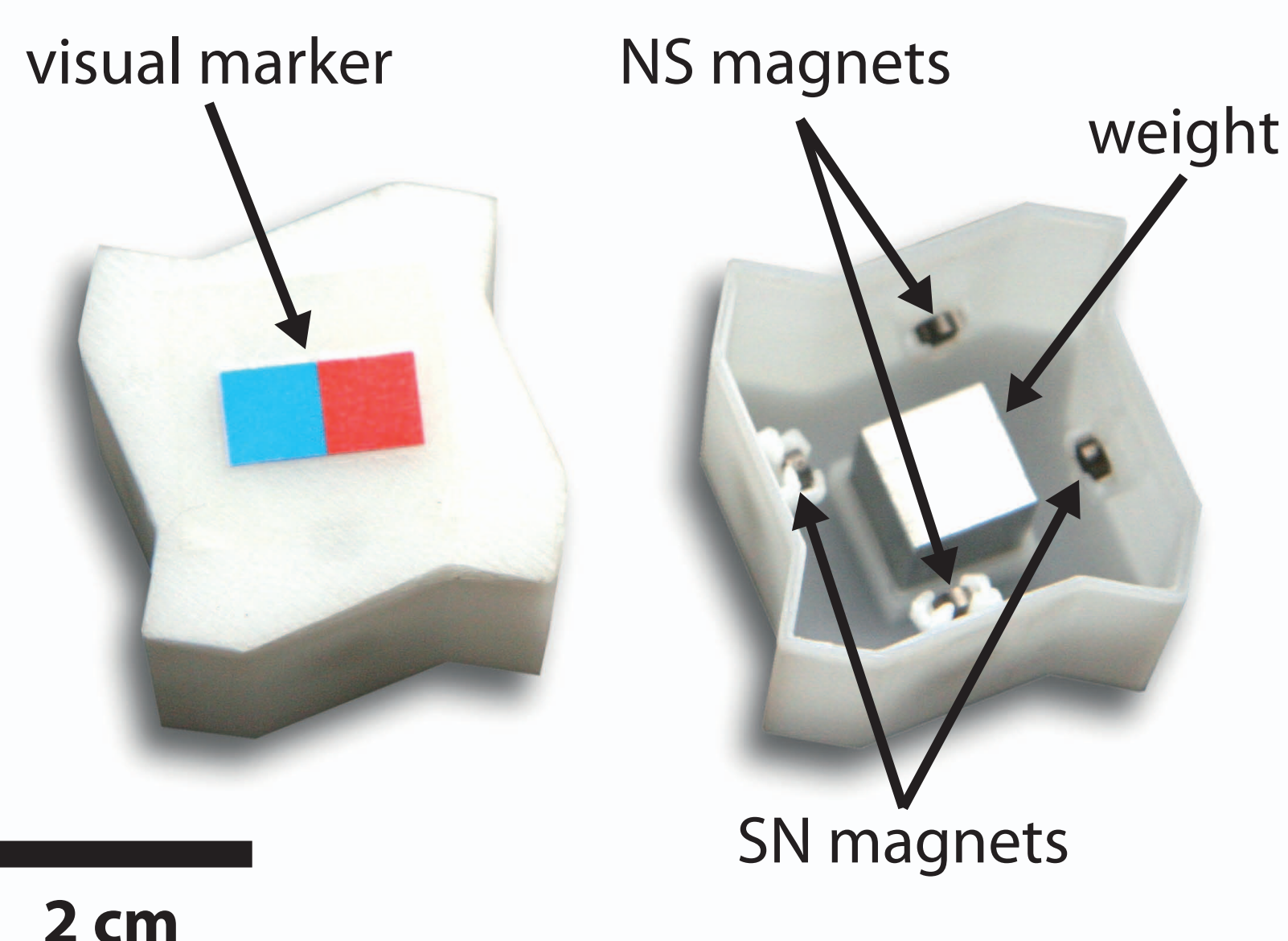


Real-time Control of Self-Assembling Systems

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Experimental platform: Lily

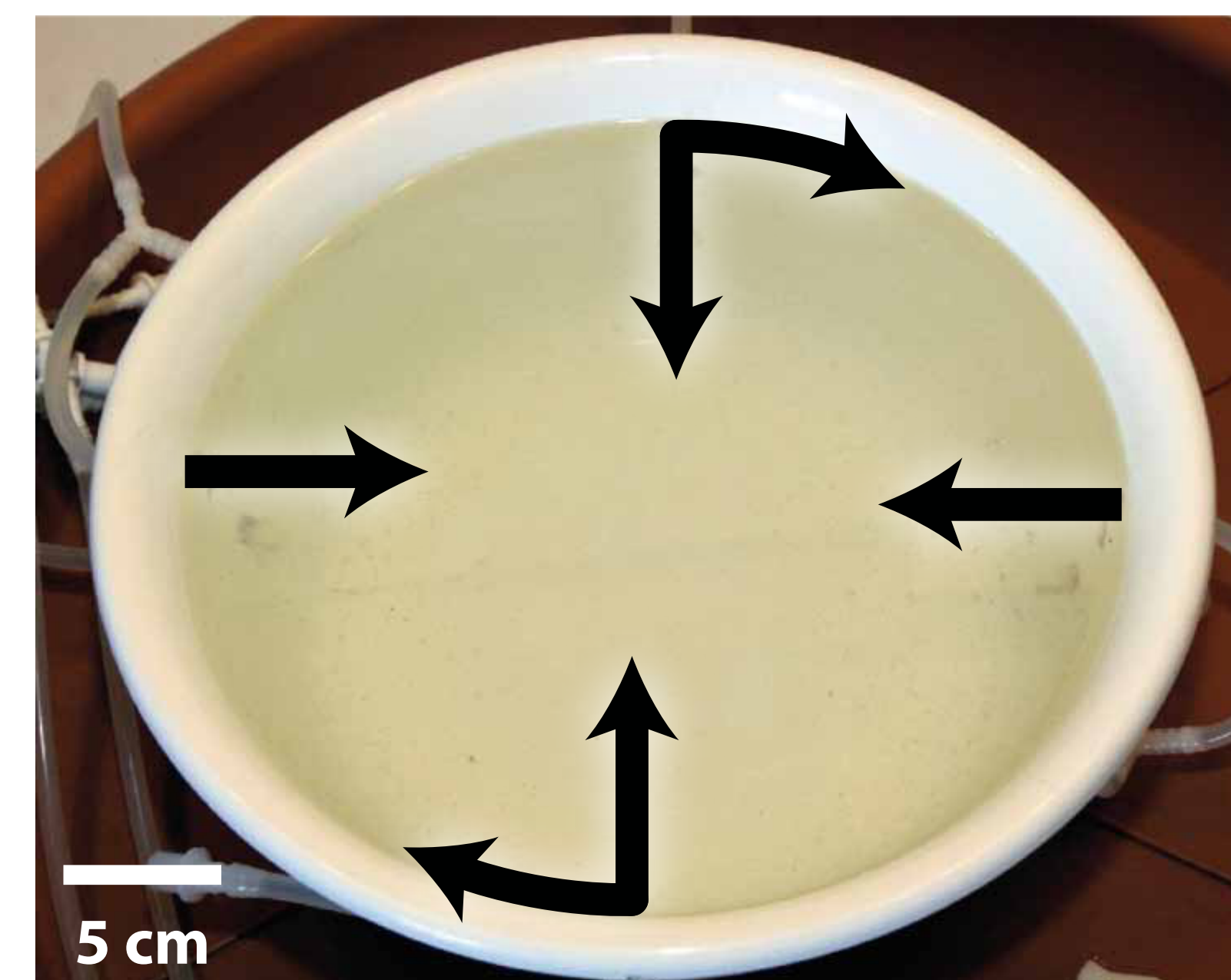
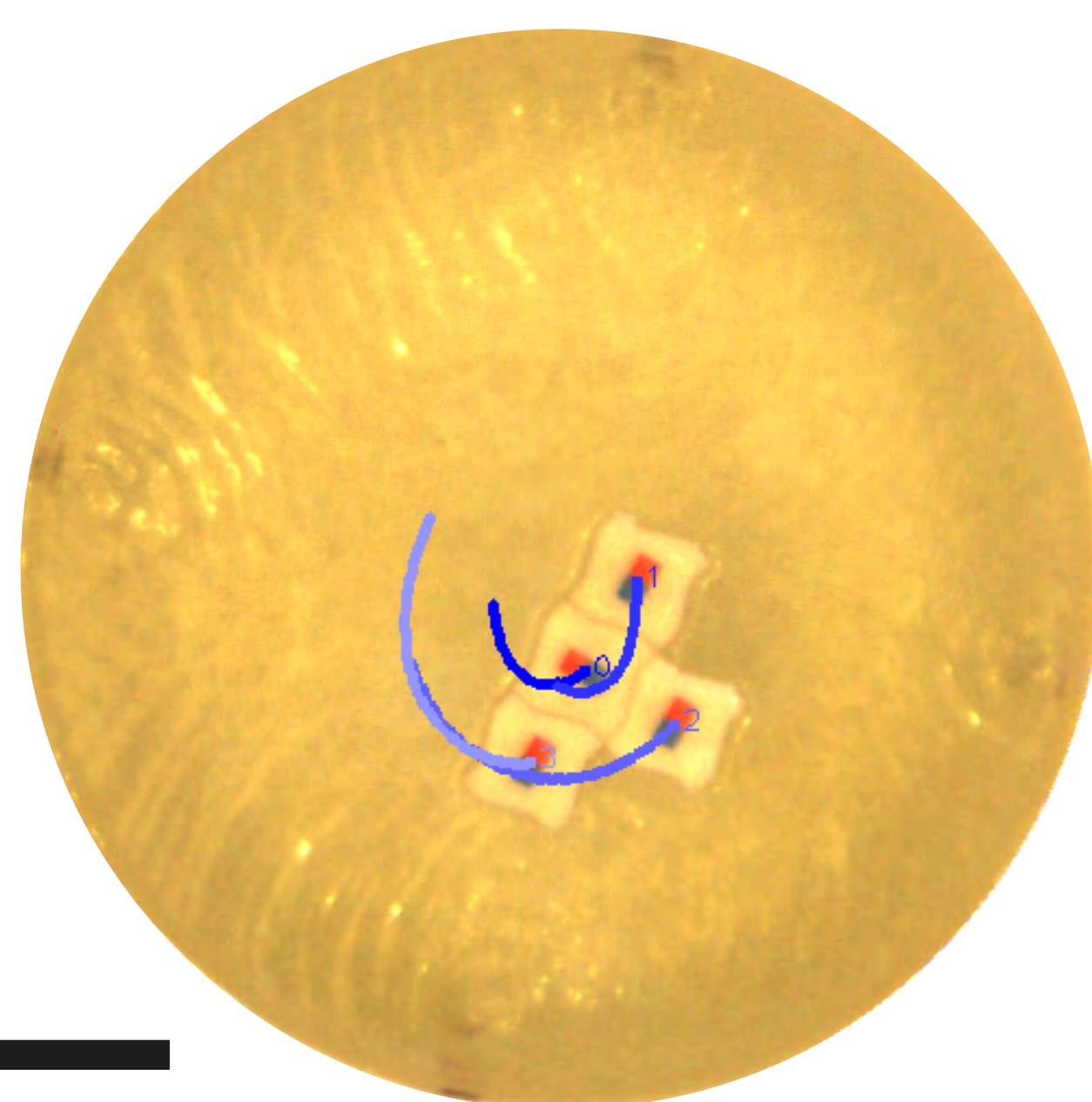


Lily's passive robots

- » Typical size: 3 centimeters
- » Swarm size: a few units
- » Latching: permanent magnets
- » Fluidic locomotion/disaggregation
- » No sensing, computation, communication

Research Question

Can we automatically
model and **control**
self-assembling systems?

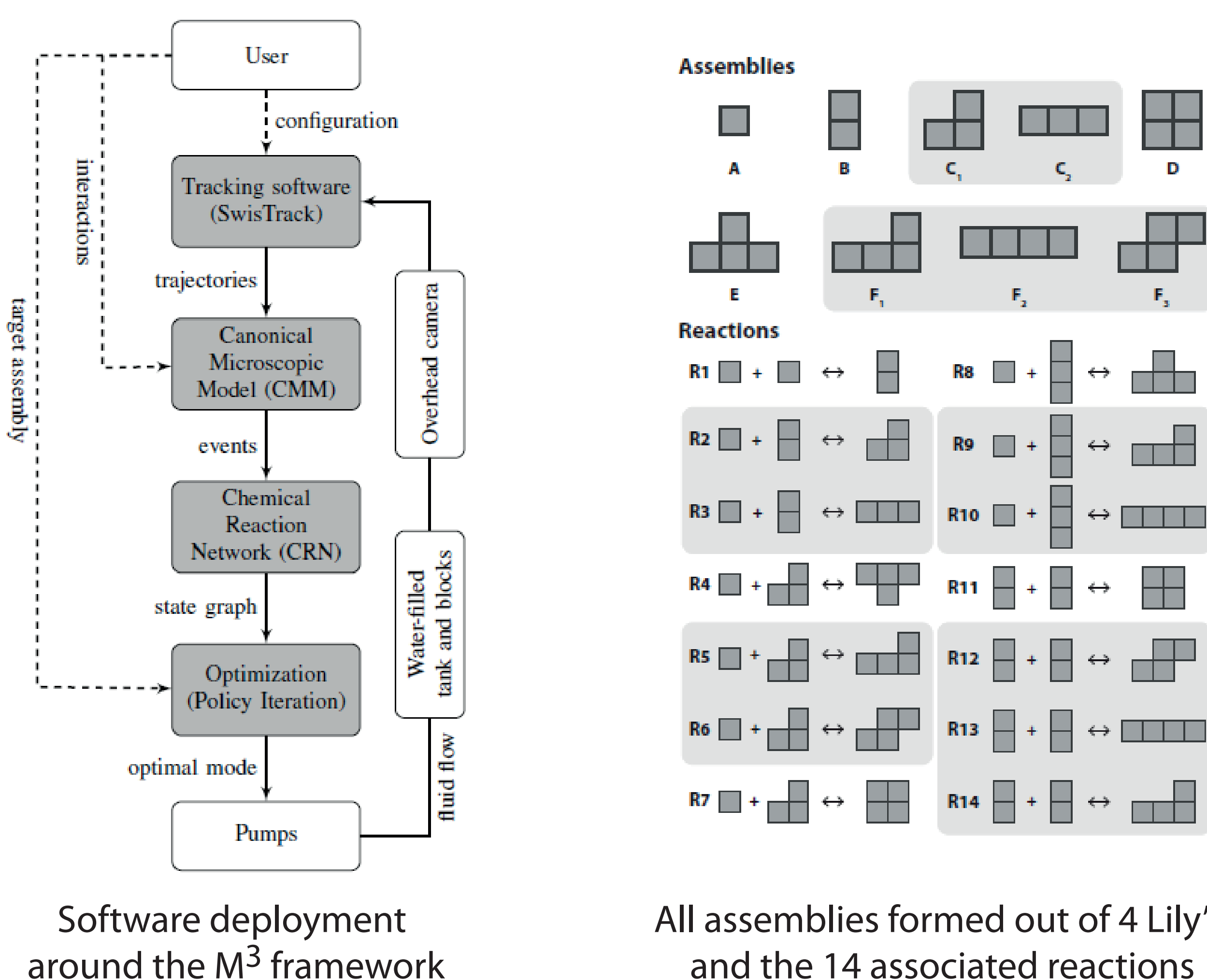
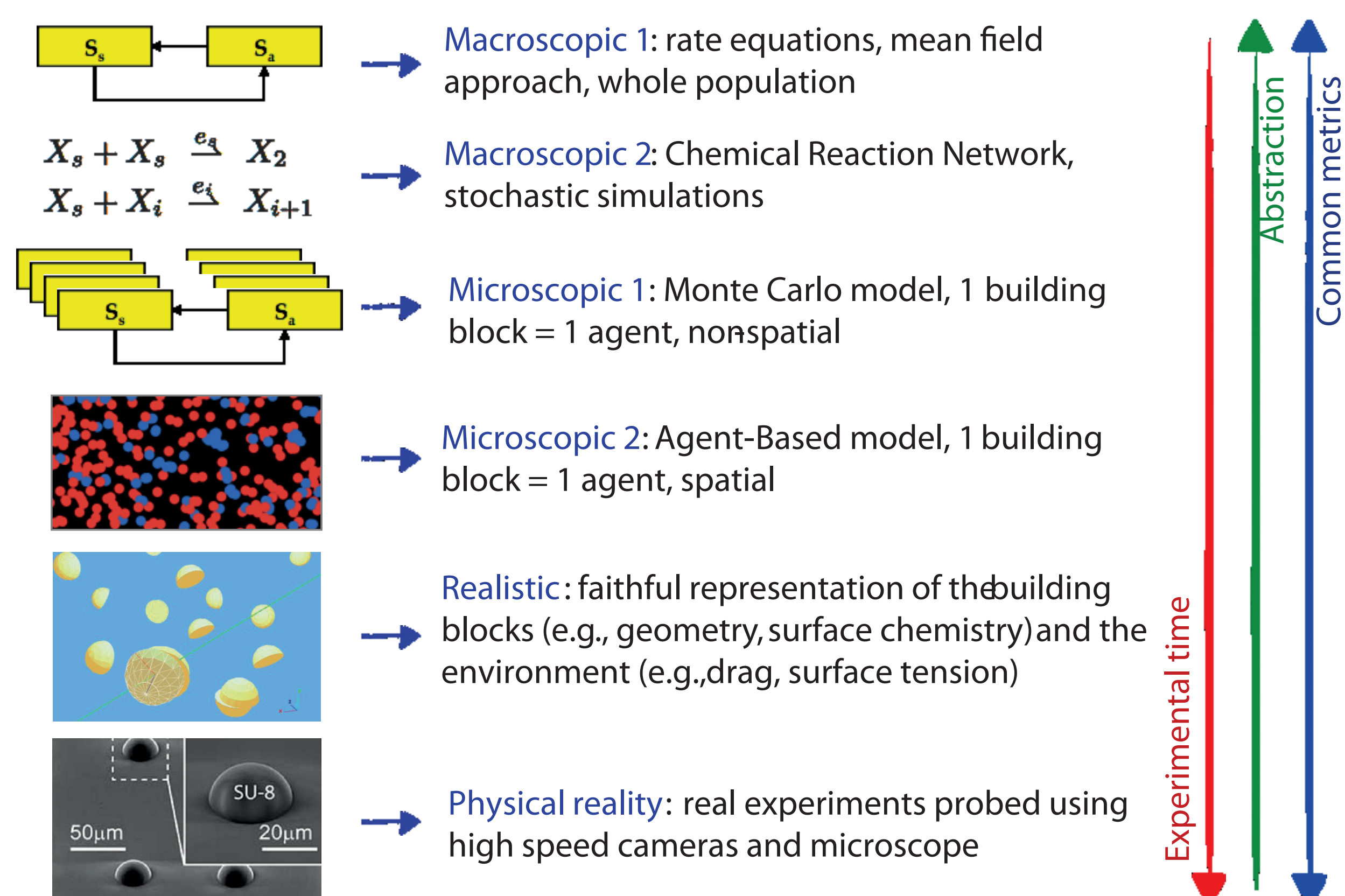


Lily's fluidic arena

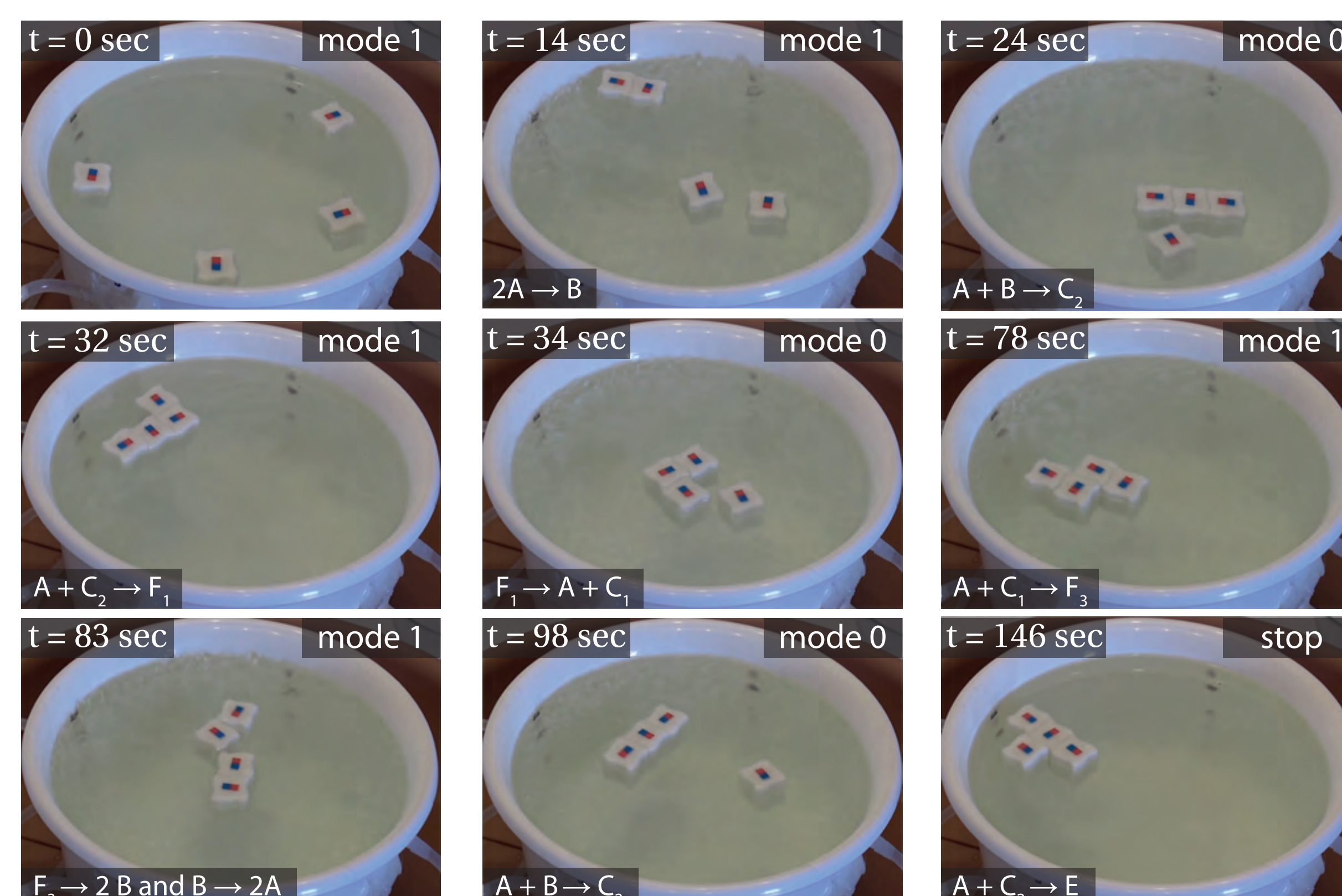
- » Tank diameter: 30 cm
- » Controllable fluidic stirring
- » Real-time visual tracking of robots through overhead camera and SwisTrak
- » M³ computational framework in the loop

Modeling & Control

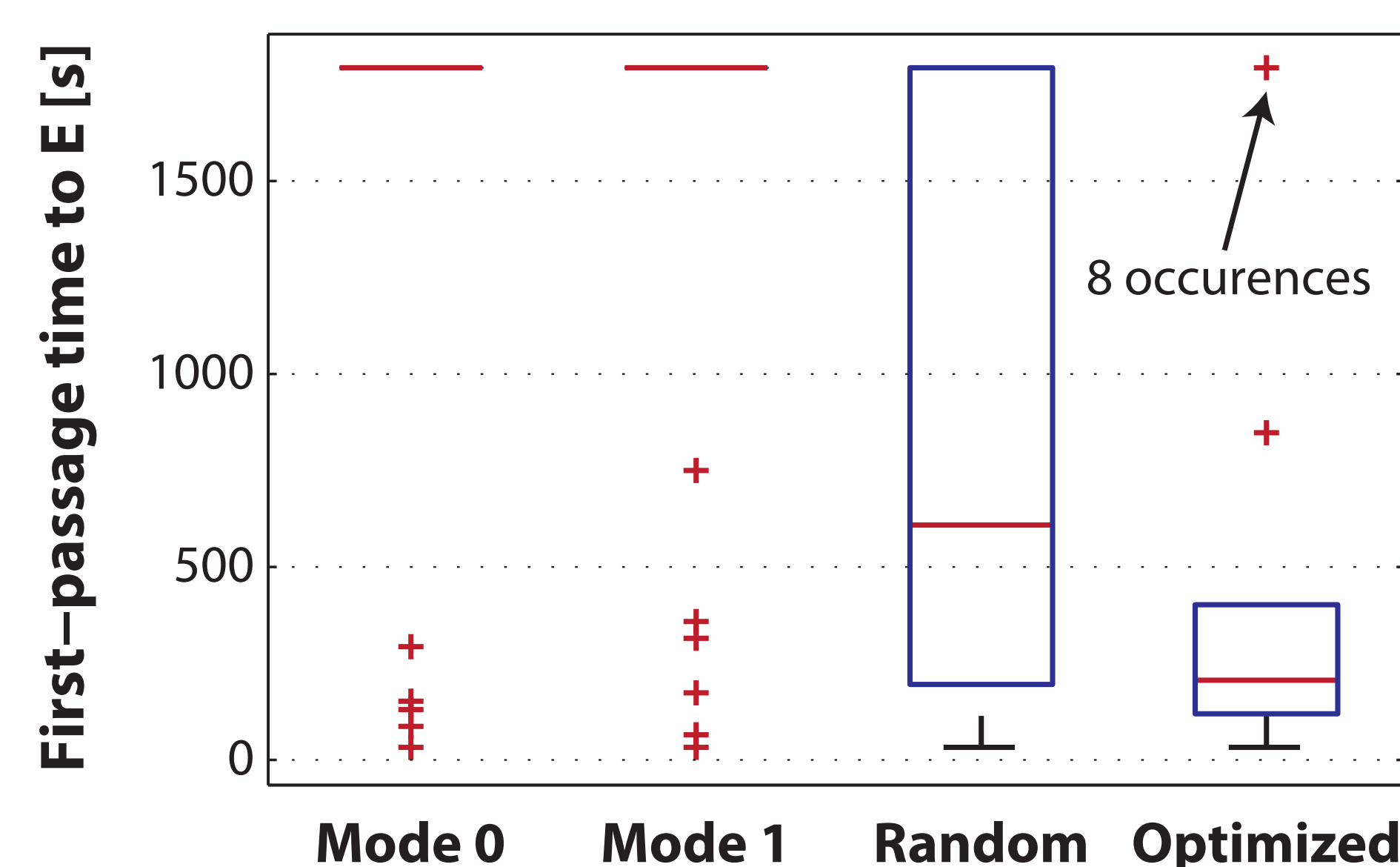
- » **Challenge:** capturing the richness of features of self-assembling systems into a single, consistent modeling framework using common metrics.
- » **Solution:** *multi-level* modeling methodology



Results & Perspective



Example of bang-bang controlled assembly run of 4 Lily's



Impact of control on assembly performance

Challenges ahead

- » System's partial observability
- » Parameters mapping and calibration
- » Automatic phase space exploration
- » Scaling of swarm and block size

Publications

- [1] Mermoud *et al.*, "Real-Time Automated Modeling and Control of Self-Assembling Systems", *IEEE Int. Conf. on Robotics and Automation* 2012.
- [2] Mermoud *et al.*, "Automated Modeling of Self-Assembling Robotic Systems: The M³ Framework", *submitted*. Full list available at <http://disal.epfl.ch>.