Cyber-Physical Materials

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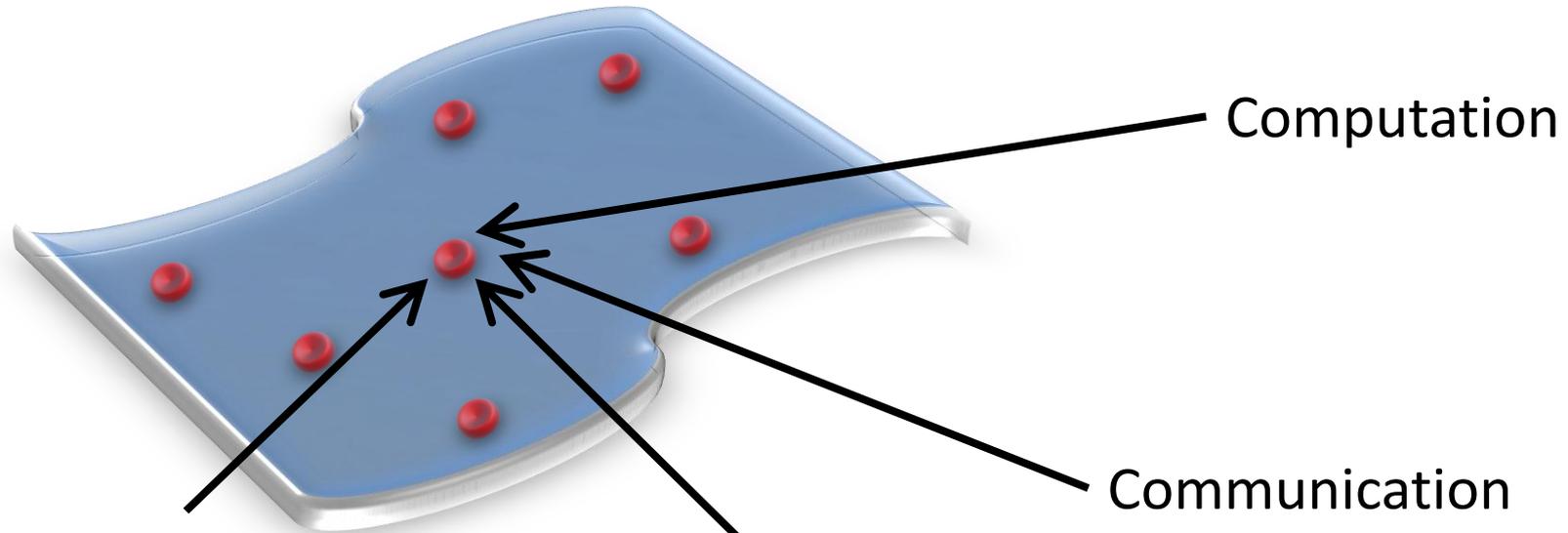
Overview

camouflage

morphable surfaces & structures

variable stiffness

Approach

Computation
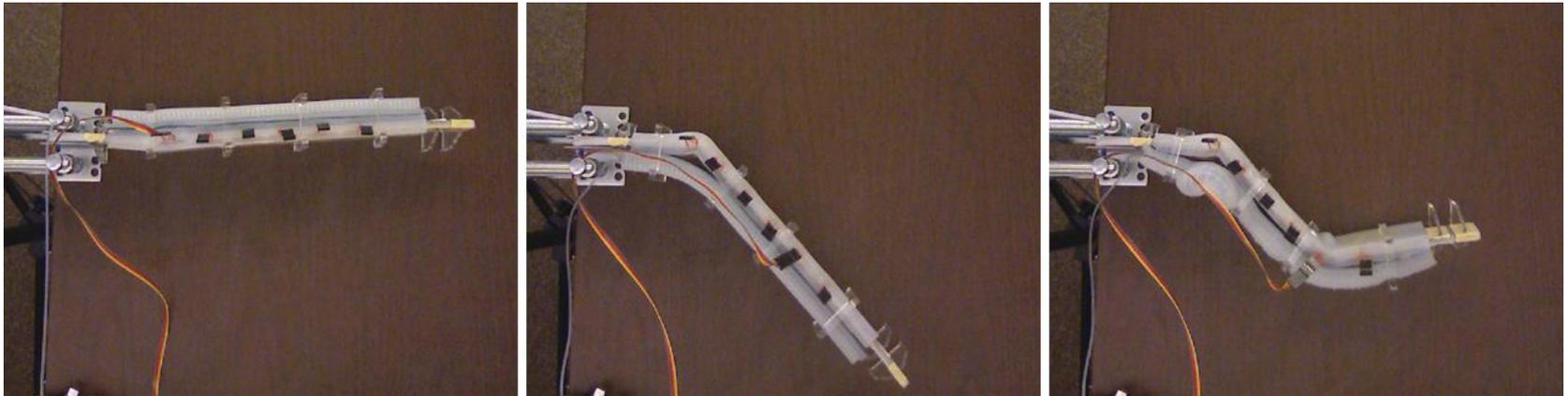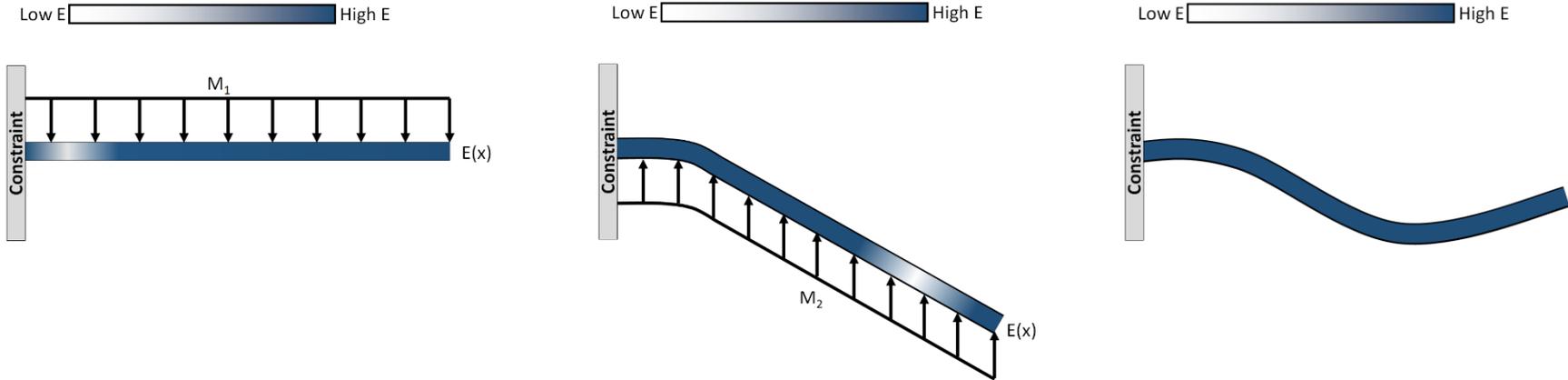
Communication

Sensing

- Accelerometers
- Thermistors
- Microphone
- Etc.

Actuation

- Heater
- Vibration Motor
- SMA
- Etc.

Abelson H, Allen D, Coore D, Hanson C, Homsy G, Knight Jr TF, et al.
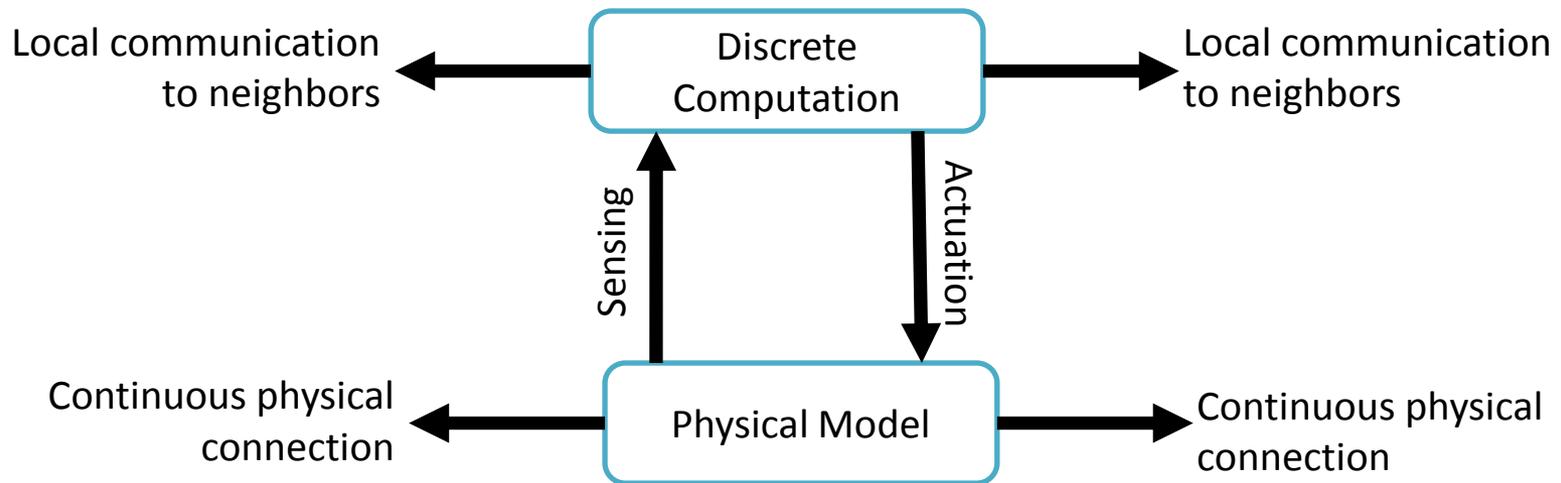Amorphous computing. Communications of the ACM. 2000;43(5):74-82

Example: Shape Change

McEvoy, M., Correll, N. (2014): Thermoplastic variable stiffness composites with embedded, networked sensing, actuation, and control. Journal of Composite Materials
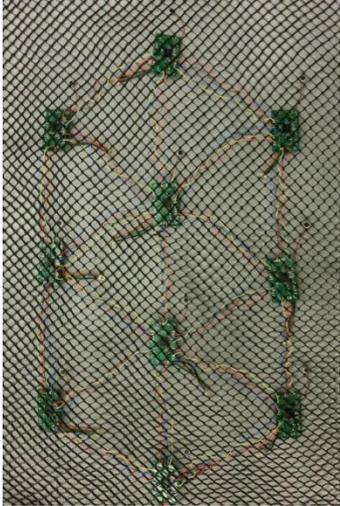
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$$\dot{E} = -p(\hat{E} - E_{set}) \Rightarrow \dot{E} \approx -p(\hat{T} - T_{set})$$

Local communication to neighbors ← **Discrete Computation** → Local communication to neighbors

Sensing ↑   Actuation ↓

Continuous physical connection ← **Physical Model** → Continuous physical connection

$$v''(x,t)E(x,t)I = M(x,t)(1 + v'(x,t)^2)^{1.5}$$

Other Cyber-Physical Materials

D. Hughes, N. Correll: A Soft, Amorphous Skin that can Sense and Localize Texture. IEEE International Conference on Robotics and Automation, Hong Kong, 2014.

H. Profita, N. Farrow, N. Correll: Flutter. In: Adjunct Proceedings of the 16th International Symposium on Wearable Computers (ISWC), pp. 44-46, 2012.

N. Correll, N. Farrow, S. Ma: Honey Comb: A platform for computational robotic materials. In: Seventh International Conference on Tangible, Embedded and Embodied Interaction (TEI), pp. 419-422, Barcelona, Spain, 2013

S. Ma, H. Hosseinmardi, N. Farrow, R. Han, N. Correll: Establishing Multi-Cast Groups in Computational Robotic Materials. In: IEEE International Conference on Cyber, Physical and Social Computing , Besancon, France, 2012.

Acknowledgements & Contact Info

- M. Andy McEvoy – michael.mcevoy@colorado.edu
- Nikolaus Correll