Abstract Submitted
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**Multicellular regulation of entropy, spatial order, and information**[1] HYUN YOUK, Delft University of Technology — Many multicellular systems such as tissues and microbial biofilms consist of cells that secrete and sense signalling molecules. Understanding how collective behaviours of secrete-and-sense cells is an important challenge. We combined experimental and theoretical approaches to understand multicellular coordination of gene expression and spatial pattern formation among secrete-and-sense cells. We engineered secrete-and-sense yeast cells to show that cells can collectively and permanently remember a past event by reminding each other with their secreted signalling molecule. If one cell "forgets" then another cell can remind it. Cell-cell communication ensures a long-term (permanent) memory by overcoming common limitations of intracellular memory. We also established a new theoretical framework inspired by statistical mechanics to understand how fields of secrete-and-sense cells form spatial patterns. We introduce new metrics – cellular entropy, cellular Hamiltonian, and spatial order index – for dynamics of cellular automata that form spatial patterns. Our theory predicts how fast any spatial patterns form, how ordered they are, and establishes cellular Hamiltonian that, like energy for non-living systems, monotonically decreases towards a minimum over time.

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Hyun Youk
Delft University of Technology

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