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Theory of optimal information transmission in E. coli chemotaxis pathway GABRIELE MICALI, ROBERT G. ENDRES, Imperial College London — Bacteria live in complex microenvironments where they need to make critical decisions fast and reliably. These decisions are inherently affected by noise at all levels of the signaling pathway, and cells are often modeled as an input-output device that transmits extracellular stimuli (input) to internal proteins (channel), which determine the final behavior (output). Increasing the amount of transmitted information between input and output allows cells to better infer extracellular stimuli and respond accordingly. However, in contrast to electronic devices, the separation into input, channel, and output is not always clear in biological systems. Output might feed back into the input, and the channel, made by proteins, normally interacts with the input. Furthermore, a biological channel is affected by mutations and can change under evolutionary pressure. Here, we present a novel approach to maximize information transmission: given cell-external and internal noise, we analytically identify both input distributions and input-output relations that optimally transmit information. Using E. coli chemotaxis as an example, we conclude that its pathway is compatible with an optimal information transmission device despite the ultrasensitive rotary motors.

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