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Signal processing in eukaryotic chemotaxis IGOR SEGOTA, ARCHANA RACHAKONDA, CARL FRANCK, Cornell University — Unlike inanimate condensed matter, living cells depend upon the detection of chemical signals for their existence. First, we experimentally determined the chemotaxis response of eukaryotic *Dictyostelium* cells to static folic acid gradients and show that they can respond to gradients as shallow as 0.2% across the cell body. Second, using Shannon's information theory, we showed that the information cells receive about the gradient exceeds the theoretically predicted information at the receptor-ligand binding step, resulting in the violation of the data processing inequality. Finally, we analyzed how eukaryotic cells can affect the gradient signals by secreting enzymes that degrade the signal. We analyzed this effect with a focus on a well described *Dictyostelium* cAMP chemotaxis system where cAMP signals are affected by an extracellular cAMP phosphodiesterase (PDE) and its inhibitor (PDI). Using a reaction-diffusion model of this set of interactions in the extracellular space, we show that cells can effectively sense much steeper chemical gradients than naively expected (up to a factor of 12). We also found that the rough estimates of experimental PDE and PDI secretion rates are close to the optimal values for gradient sensing as predicted by our model.

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