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A Robust Feedforward Model of the Olfactory System[1] YILUN ZHANG, TATYANA SHARPEE, Salk Institute for Biological Studies and University of California San Diego — Most natural odors have sparse molecular composition. This makes the principles of compressing sensing potentially relevant to the structure of the olfactory code. Yet, the largely feedforward organization of the olfactory system precludes reconstruction using standard compressed sensing algorithms. To resolve this problem, recent theoretical work has proposed that signal reconstruction could take place as a result of a low dimensional dynamical system converging to one of its attractor states. The dynamical aspects of optimization, however, would slow down odor recognition and were also found to be susceptible to noise. Here we describe a feedforward model of the olfactory system that achieves both strong compression and fast reconstruction that is also robust to noise. A key feature of the proposed model is a specific relationship between how odors are represented at the glomeruli stage, which corresponds to a compression, and the connections from glomeruli to Kenyon cells, which in the model corresponds to reconstruction. We show that provided this specific relationship holds true, the reconstruction will be both fast and robust to noise, and in particular to failure of glomeruli. The predicted connectivity rate from glomeruli to the Kenyon cells can be tested experimentally.

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