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Distributed multisensory integration in a recurrent network model through supervised learning HE WANG, K. Y. MICHAEL WONG, Hong Kong University of Science and Technology — Sensory integration between different modalities has been extensively studied. It is suggested that the brain integrates signals from different modalities in a Bayesian optimal way. However, how the Bayesian rule is implemented in a neural network remains under debate. In this work we propose a biologically plausible recurrent network model, which can perform Bayesian multisensory integration after trained by supervised learning. Our model is composed of two modules, each for one modality. We assume that each module is a recurrent network, whose activity represents the posterior distribution of each stimulus. The feedforward input on each module is the likelihood of each modality. Two modules are integrated through cross-links, which are feedforward connections from the other modality, and reciprocal connections, which are recurrent connections between different modules. By stochastic gradient descent, we successfully trained the feedforward and recurrent coupling matrices simultaneously, both of which resembles the Mexican-hat. We also find that there are more than one set of coupling matrices that can approximate the Bayesian theorem well. Specifically, reciprocal connections and cross-links will compensate each other if one of them is removed. Even though trained with two inputs, the network's performance with only one input is in good accordance with what is predicted by the Bayesian theorem.

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