

Heterogeneous Neural Networks for Adaptive Behavior in Dynamic Environments

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Abstract: Research in artificial neural networks has generally emphasized homogeneous architectures. In contrast, the nervous systems of natural animals exhibit great heterogeneity in both their elements and patterns of interconnection. This heterogeneity is crucial to the flexible generation of behavior which is essential for survival in a complex, dynamic environment. It may also provide powerful insights into the design of artificial neural networks. In this paper, we describe a heterogeneous neural network for controlling the walking of a simulated insect. This controller is inspired by the neuroethological and neurobiological literature on insect locomotion. It exhibits a variety of statically stable gaits at different speeds simply by varying the tonic activity of a single cell. It can also adapt to perturbations as a natural consequence of its design.