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Hippocampal pyramidal neurons, or place cells, can represent physical space by creating and maintaining a map of the world. The physical world's continuous nature suggests that an accurate and useful map must also be continuous. Because the hippocampus does not contain enough neurons for each one to only represent one location in physical space, its map of space must re-use neurons. Experiments have demonstrated that one place cell may represent multiple regions in one environment. However, maps of different environments need not be completely independent or orthogonal – depending on the familiarity, some neurons may remap, and others may not. Furthermore, if the rat switches to a different task, the network activity switches accordingly. These results suggest that the hippocampus has a continuous, intrinsic representation of space, which can both maintain stable states, and dynamically morph from one state to another. Several existing models have explained aspects of these phenomena. Complete remapping, the occurrence of seemingly orthogonal place fields for a neural ensemble, has been explained by implementing attracter networks with discrete maps, or charts. Other simplified models have simulated partial remapping, wherein some place cells will remap independently of the other cells. Our model assumes a continuous combinatorial representation of space by random re-use of cells. It may mechanistically explain many hippocampal network computations, most importantly how it can partially remap and maintain a simultaneous representation of multiple maps. By utilizing an anatomically- and physiologically-based recurrent network of integrate-and-fire neurons, we demonstrate a mechanism for the emergence of these properties. The simulation results help provide explicit suggestions for experiments that will further unravel these principles.

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