Noise-induced chimeras in dynamical networks: nonlocally coupled ring versus 2D modular fractal connectivity

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For a network of coupled neural elements in the excitable regime we show that chimera patterns can be induced by noise. We compare the results for two different network topologies: nonlocal coupling on a ring and 2D modular fractal connectivity with the latter being relevant for modeling of the brain. In contrast to classical chimeras, occurring in deterministic oscillatory networks, these patterns have features of two phenomena: coherence resonance and chimera states. Therefore, we call them coherence-resonance chimeras [1]. They demonstrate the constructive role of noise and appear for intermediate values of noise intensity, which is a characteristic feature of coherence resonance. In the coherence-resonance chimera state a neural network of identical elements splits into two coexisting domains with different behavior: spatially coherent and spatially incoherent, a typical property of chimera states. Interestingly, these noise-induced chimera states are characterized by alternating behavior: coherent and incoherent domains switch periodically their location. We show that this alternating switching can be explained by analyzing the coupling functions [2]. Moreover, we investigate the impact of time delay on coherence-resonance chimeras and demonstrate that time delay can be used to control the noise-induced chimera states. In more detail, the interval where coherence-resonance chimeras exist can be significantly increased by introducing time-delayed feedback.

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