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Chimera, criticality and cooperation

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Abstract

The three-headed, fire-breathing - part lion, part goat and part serpent - chimera was thought to be an appropriate label for a state that unexpectedly appeared a decade ago in nonlinear dynamic calculations. This new state consists of coexisting coherent and incoherent parts, a theoretical odd-fellow. Chimera states have subsequently been observed in multiple theoretical studies and experiments in systems with finite-range non-local coupling. Our research group has recently discovered a source of such states that does not require the ubiquitous assumption of non-local coupling and instead uses a complex network dynamical model that undergoes phase transitions. This decision making model (DMM) has been previously shown to describe the task-induced neuronal avalanches that occur in the human brain and that relate the inverse power-law distribution of such events to the underlying critical dynamics. The cooperative long-range coupling emerging from the DMM critical dynamics is shown to also give rise to a chimera state. We speculate that such critical dynamics may provide an explanation for the asymmetrically coherent and incoherent brains of dolphins and other sea animals during unihemisphere sleeping.