

Local control for the collective dynamics of self-propelled particles

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Abstract

Using a paradigmatic model of self-propelled, interacting particles, this presentation will demonstrate how local accelerations at the individual particle level can induce transitions between distinct collective dynamics, thereby enabling a control mechanism. Our findings show that the ability to trigger these transitions is hierarchically distributed among the particles, giving rise to distinct spatial patterns within the collective. These particle hierarchies offer decentralized control potential for both natural and artificial systems composed of interacting elements. Moreover, an analysis of the transient dynamics during these transitions reveals chaotic behavior associated with unstable chaotic sets, which play a key role in mediating the control process.