Title: Models and Control of Collectives: A Geometric Perspective

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Abstract: By treating the individual agents as self-steering particles, we will discuss two different strategies for collective motion. In the first part of the talk, we will continue the earlier discussion on the beacon-referenced cyclic pursuit system (CBB) to investigate pure shape equilibria in this framework. By introducing a change of variables, we will show the existence of a family of invariant manifolds, which correspond to spiral motions while preserving the shape of the collective up to geometric similarity. Such motions can be put to practical use for region exploration in search-and-rescue type missions. In the second part of the talk we will introduce Topological Velocity Alignment (TVA), another strategy for collective motion, wherein the individual agents move in the same direction by exploiting knowledge of the movement of local neighbors. After providing a rigorous analysis of a special two-agent case, we will demonstrate via numerical simulation and robotic implementation that the proposed framework can be scaled up to control larger collectives. We will also demonstrate that this strategy can yield splitting behavior, similar to the one observed in biological collectives (e.g. starling flocks).