

Meeting: 1001, Evanston, Illinois, SS 15A, Special Session on Mathematical Problems in Robotics

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PA 19104. *Control of Shape and Distribution for Swarming Behaviors*. Preliminary report.

We address the synthesis of controllers for large networked groups of small vehicles and sensors operating in dynamic, resource-constrained environments. Due to the large numbers and the need for a system that must be robust to the addition and deletion of new vehicles, each agent has to be *anonymous*. Further, each node has to operate asynchronously, and must be agnostic to who its neighbor is. We first consider the specific problem of controlling a large group of robots to synthesize shapes specified by 2D curves S given by implicit functions of the form $s(x, y) = 0$. This implicit function can be viewed as the zero isocontour of a 3D curve $f = s(x, y)$ whose value is less than zero for all points that are inside the S boundary and is greater than zero for points outside the boundary. We derive decentralized controllers that allow the robots to converge to S and spread along or inside the curve. We also consider the problem of synthesizing plans for the group of robots. We consider functions that are weighted sums of radial basis functions created by interpolating from a set of constraint points. We describe the generation of plans for swarms of robots and illustrate the use of decentralized controllers that realize these plans through simulations and experiments. (Received August 27, 2004)