

We envision programmable matter consisting of systems of computationally limited devices (which we call particles) that are able to self-organize in order to achieve a desired collective goal without the need for central control or external intervention.

A central problem for these particle systems is shape formation.

In this talk, I present our result that we published at SPAA 2016, i.e., a universal shape formation algorithm which takes an arbitrary seed shape composed of equilateral triangles of unit size and lets the particles build that shape at a scale depending on the number of particles in the system.

Our algorithm runs in $O(\sqrt{n})$ asynchronous execution rounds, where n is the number of particles in the system, provided we start from a well-initialized configuration of the particles.

This is optimal in a sense that for any shape deviating from the initial configuration, any movement strategy would require $\Omega(\sqrt{n})$ rounds in the worst-case (over all asynchronous activations of the particles).

Our algorithm relies only on local information (e.g., particles do not have ids, nor do they know n , or have any sort of global coordinate/orientation system), and requires only a constant-size memory per particle.