1135-68-2662 **David Doty*** (`doty@ucdavis.edu`), One Shields Ave, University of California, Davis, CA 95616.
Hardness of computing and approximating predicates and functions with leaderless population protocols.

Population protocols are a distributed computing model appropriate for describing massive numbers of agents with very limited computational power, such as programmable chemical reaction networks in synthetic biology. A population protocol is said to require a leader if every valid initial configuration contains a single agent in a special "leader" state that helps to coordinate the computation. Although the class of predicates and functions computable with probability 1 is the same whether a leader is required or not, it is not known whether a leader is necessary for fast computation.

We show that a wide class of functions and predicates computable by population protocols are not *efficiently* computable, nor are some linear functions even efficiently *approximable*. For example, the widely studied parity, majority, and equality predicates cannot be computed in sublinear time. It requires linear time for a population protocol even to approximate division by a constant or subtraction: for sufficiently small gamma > 0, the output of a sublinear time protocol can stabilize outside the interval f(m) (1 +/- gamma). We show that it requires linear time to exactly compute many semilinear functions (e.g., f(m)=m if m is even and 2m if m is odd) and predicates (e.g., parity, equality). (Received September 26, 2017)