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ON A MATHEMATICAL THEORY OF COMPLEX SYSTEMS ON NETWORKS WITH APPLICATION TO OPINION FORMATION

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This paper presents a development of the so-called kinetic theory for active particles to the modeling of living, hence complex, systems localized in networks. The overall system is viewed as a network of interacting nodes, mathematical equations are required to describe the dynamics in each node and in the whole network. These interactions, which are nonlinearly additive, are modeled by evolutive stochastic games. The first conceptual part derives a general mathematical structure, to be regarded as a candidate towards the derivation of models, suitable to capture the main features of the said systems. An application on opinion formation follows to show how the theory can generate specific models.

Keywords: Living systems; networks; self-organization; nonlinear interactions; learning; opinion formation.

1. Introduction

The scientific community agrees that the design of mathematical tools toward an effective interplay between the physics of complex systems and mathematical sciences is one of the important challenges of this century, which can arguably contribute to substantial developments in various research fields related to the living matter. This specific interest is documented in selection by all American Mathematical Societies of the aforesaid topic as the awareness issues for 2011:

> [Unraveling *Complex* Systems.] "We are surrounded by complex systems. Familiar examples include power grids, transportation systems, financial markets, the Internet, and structures underlying everything from the environment to cells in our bodies. Mathematics and statistics can guide us