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Problems of Saturated Flows Modeling on Networks

B Srinivasan*

Department of Applied Mathematics, SRM Institute of Science and Technology, Tamilnadu, India

Perspective

Dynamical systems with particle cluster flows on circles, forming a daily network structure are often used for analyzing transport flows, in biology (metabolism), in materials science (particles movement on periodic structures, for instance in crystal lattices). A category of dynamical systems on regular contour graphs is studied within the paper. The study of closed and open chains of contours has revealed that there are structures such, during a certain sense, these structures are often classified as Sturm-Liouville-type spectrum. During this paper, new analytical results are obtained for contour networks that are closed or open chains of contours.

The theoretical aspect of the matter, considered during this paper, is that the look for a basis and formal rules of describing models functioning such these rules describe results of various physical experiments adequately. These experiments are observed in various sciences. These sciences are system biology, material science, pharmacology, etc. These sorts of models attract researcher's attention that's initiated by problems of saturated flows modelling on networks during a broad sense and specifically the matter of describing the metropolis traffic. A category of deterministic and stochastic dynamical systems has been introduced and studied. These systems describe movement of particles or clusters on a system of circles that are connected at certain points (nodes).

Direct approaches associated with the so-called agent-based modeling, despite variety of obvious successes, associated primarily with the rapid development of technology, and are currently facing insufficient processing speed of huge data. Virtually all analytical results for such deterministic and stochastic systems ask the movement of particles on an isolated circuit, are simple versions of the traffic model was introduced. Forty years ago, the thought of quantum computers development. And today it's far away from perfect state and yet doesn't justify the hopes related to them. Thus traditional approaches, when mathematical model took a worthy place during a science experiment, are returning to its rightful place model a priori analysis an efficient computational process.

The aim of study is to investigate the conditions of system resulting in a state of free movement or a collapse state. Free development framework state compares to group development right away as at current second as later on. Collapse state corresponds to the movement when all groups stop. These two outrageous subjective states are analogs of the first and last mark of the range, for instance, a symmetric limited dimensional operator (grid). The value of velocity equals 1 in the case of free movement. The value of velocity equals 0 in the case of collapse.

A discrete version of flows on ring of contours has been introduced and studied. The aim of the works is to supply an appropriate mathematical apparatus for describe the dynamical systems, because practically no exact statements were known. Especially, the study of linear chains of contours has revealed that there are structures that during a certain sense are often classified because the Storm-Liouville-type spectrum. Movement rules of particles are often associated with the principles for elementary cellular automata CA 184 and CA 240 in classification of S.Wolfram.

In accordance with results, within the Nalel-Schreckenberg model with an isolated contour, the speed of particles may be a function of the flow density and doesn't depend upon the initial state. This is often not according to the three-phase traffic theory, which has been developed by B.S. Kerner. The three-phase theory is according to empirical data describing the Behavior of real transport flows. In accordance with the three-phase traffic theory, a transport flow may result either within the phase of free movement or within the phase of jam from an intermediated phase, with some probabilities. A mathematical stochastic traffic model, which is consistent to the three-phase theory, has been introduced. The behaviour of this model is analogous to the Behavior of contours systems. In accordance with results of velocities of particles on contours aren't functions on only flow densities. These velocities can depend upon the initial state of a system and, within the stochastic case; the velocities of particles can depend upon the random realization of the method. Velocities of particles correspond to sets of repeating states called spectral cycles. The set of spectral cycles with corresponding values of velocities is named the spectrum. We study the spectrum of contour systems.

The normal distance that a group for every a period unit is known as the average velocity of the particle. The average value of normal velocities of particles is known as the average velocity of the system. On the off chance that a direction, starting with a specific time, has a limited period, the relating normal framework speed is known as the spectral value and the periodic dependence on time will be known as the spectral function or spectral cycle.

***Address for Correspondence:** B Srinivasan, Department of Applied Mathematics, SRM Institute of Science and Technology, Tamilnadu, India, E-mail: srinivasan@gmail.com*

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