

Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Topic: Traffic Flow

Preference: Oral

EMPIRICAL AND SIMULATIONAL ANALYSIS OF THE JAM FORMATION FOR A PROBLEMATIC HIGHWAY IN TURKEY

M. L. Kurnaz^{*}, A. N. Imrem

Department of Physics, Bogazici University 34342 Bebek Istanbul TURKIYE

^{*} Electronic Address: levent.kurnaz@boun.edu.tr

We are stuck in a jam on traffic everyday and it is one of the most significant problems faced in modern cities today. In Istanbul, people generally work on the European side and live on the Asian side. The traffic therefore flows at the direction of the western side in the morning, and at the direction of the eastern side in the evening along the two bridges. Due to the fact that when 25 lanes come from the western side after the toll booths and the number of lanes is decreased to 4, traffic jams become a huge problem. Traffic research still cannot fully predict under which conditions a traffic jam may suddenly occur. The aim of our project is to define what causes such traffic jams from a physicist point of view. The possible reasons for the jam formation can be the frequent lane changing or less headway, high density or sudden braking. These parameters and their effect to the traffic flow should be investigated individually. In this simulation, the local vehicle density and flow values, and position of each vehicle for each time step are measured. The respective dependencies among these quantities, so-called fundamental diagrams, are plotted. Traffic modeling is distinguished as microscopic and macroscopic. Macroscopic approach maps traffic flow as a continuous unity of fluidized vehicles. No vehicle in the traffic flow is identifiable. Microscopic modeling maps traffic flow as a set of individual vehicles. We propose microscopic cellular automata rules for modeling highway consisting of four lanes, an onramp, an off-ramp, and an auxiliary lane in Istanbul. Cellular Automata have the advantage of modeling the traffic flow on the microscopic scale of individual vehicles and allow the study of large systems due to a simple type of dynamics. We use the Nagel-Schreckenberg (NaSch) microscopic model to simulate the traffic flowing from the European side to Asian side over the Bosphorus on the Fatih Sultan Mehmet Bridge. We also investigate phase transition and its order with real traffic data from government traffic control center. The transportation authority makes an arrangement in order to decrease the traffic jam, by taking one lane from the direction from eastern side to western side and adds this lane to the crowded side as an auxiliary lane at the rush hours. The effectiveness of the auxiliary lane at this portion of the road is investigated. To test the psychological aspects of the driver behavior and cultural side of the traffic flow problem, two scientists from different ethnic background approach this problem using different parameters related to their traffic cultures and perception of rules. The results are given as a comparative study of these two simulations. This project has been supported by Bogazici University BAP 07B303D project.