Chapter 8
Mathematical Modeling of Information Warfare in Techno-Social Environments

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ABSTRACT

The chapter discusses a number of mathematical models of information battle in techno-social environments. Some models take into account such battle factors as the mass information media's incomplete coverage of the society, the individuals' acquisition of the information only after receiving it twice, the individuals' forgetting the information, a priori bias to support a party to the battle, and polarization of the society. For simpler models, the results are described in brief. For more complicated ones, mathematical research has been conducted with the sociological interpretation of the results.

INTRODUCTION

The value of information for both an individual and the society had been realized long before the very word emerged. Many technological achievements and inventions were adapted by people for storing or spreading the information in this way or another

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while other inventions were designed directly for that. Nowadays it can be spoken about the united techno-social environment that encompasses both the individuals, technical means and carriers. The environment is a field for spreading the rumors, gossips, urban legends, commercial advertisement and political propaganda. In some cases, two antagonistic information streams are transmitted in the society, e.g. ones that carry the opposite evaluations of one and the same political event. In this case, one may talk of an information battle process. This chapter is dedicated to several models of the process.

BACKGROUND

A review of sociological literature on this area of focus could be a multi-volume edition itself, so here it is only the works of Herman and Chomsky (2006), DiFonzo and Bordia, (2005, 2007), Pronchev and Muraviov (2011) that will be mentioned. The authors by no means claim their review to be neither exhaustive nor representative but they rather proceed from their own preferences.

The first mathematical single rumor spreading models were suggested quite a long ago (Daley & Kendall, 1964; Maki & Thompson, 1973). In the most general terms, these models assume that at each time point some individuals from those making up a social group possess certain information and transmit it to other individuals. Thus, the information is propagated. The deterministic and stochastic models are distinguished, and in some cases - deterministic and stochastic variants of one and the same model. In this work it is only the deterministic models that are considered.

The mechanics of the Daley-Kendall model looks as follows. At each time point, each member of the society belongs to one of the three classes: ignorants, spreaders, or stiflers. Ignorants are not yet aware about the rumor; spreaders know the rumor and propagate it, while stiflers know it but do not spread it. Initially, one member of the society is a spreader, and all the other ones – ignorants. Contacts between the individuals are described in the molecular-kinetic terms: e.g., the frequency of meetings between ignorants and spreaders is proportional to the multiplication of the current quantities of these classes (certainly this implies the homogeneity of the society). The individuals can pass from one class to another in three cases: (i) if an ignorant meets a spreader, the ignorant also becomes a spreader, (ii) if two spreaders meet, then both of them become stiflers, and (iii) if a spreader meets a stifler, the spreader becomes a stifler too. Hereinafter the spreaders passing to the class of stiflers will be called the stifling effect.

The distinction of the Maki-Thompson model prerequisites consists in only one spreader turning into a stifler when two spreaders interact (the second one remains a spreader), i.e. in a more limited character of the stifling-effect.