Dynamic games with incomplete information applied to optimization of military radio networks — jamming avoidance

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We present a model of planning frequency assignment by a mobile military communication network taking into account not only internal interference of planner's own system but also potential presence of a rational opponent. To do this, we use dynamic games with incomplete information and the concepts of belief distorted Nash equilibria, both in deterministic and stochastic form of expectations. This analysis allows us to find remedies to several types of behaviour of the opponent.

Modern systems of radio communication planning has two aims: ensuring both internal and external compatibility of the system (i.e. avoiding both interference within the network and jamming or interference by other sources). Currently, systems of planning concentrate only on ensuring internal compatibility of the radio system and avoiding usual interference from external sources. The part of ensuring external compatibility of the radio system related to avoiding jamming was carried out by using appropriate mode of radios, ex. frequency hopping mode, free channel search mode, etc. With this approach, we had no information about efficiency of the methods used. In particular, we had no information whether we have made the radio nets immune to jamming. The only information that we obtain is a runtime information, whether jamming have appeared, which is subsequently not utilized in any way.

From theoretical point of view, in existing approaches, the problems of frequency assignment for a mobile military communication network in various time instants are treated as independent static optimization problems with only one decision maker. First of all, we have to be conscious, that we face not a simple optimization problem, but a game: besides our communication network, there may be an opponent, whose aim is to detect and/or jam our transmission. Besides, a dynamic character of interaction has to be taken into account: using a plan of frequencies defined *a priori* and switching to the same reserve plans in predefined way whenever jamming appears, makes it possible for the counteracting unit of the opponent to uncover the rules of our behaviour. Using dynamic game theory, in particular dynamic games with incomplete information, allows us to utilize information about rules of behaviour of the opponent during the process of frequency planning. The side which takes the dynamic character of the decision making problem into account as the first can benefit from this fact.

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