Exploring the Future by Anticipatory Networks

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Abstract. We present the theory of anticipatory networks that bases on the anticipatory models of consequences in multicriteria optimization problems presented in [2] and extends the theory of anticipatory networks presented in [3,4]. When making a decision, the decision-maker takes into account the anticipated outcomes of each future decision problem linked by the causal relations with the present one. In a network of linked decision problems the causal relations are defined between the time-ordered nodes. The scenarios of future consequences of each decision are modelled by multiple vertices starting from an appropriate node. The network is supplemented by one or more relations of anticipation, or future feedback, that describes a situation where decision-makers take into account the anticipated results of some future optimization problems while making their choice. Both types of relations as well as forecasts and scenarios regarding the future model parameters form an information model, called the *anticipatory network*. We will present the properties of anticipatory networks and propose the method of their reduction, transformations and computing. Anticipatory networks are asynchronous and may serve to define a causal field that replaces the notion of time. Motivated by the properties of the anticipatory networks, we define the superanticipatory systems and present their basic properties. By definition, a superanticipatory system is a system that is anticipatory in the sense of Rosen and contains a future model of at least one other anticipatory system that may influence its current decisions. It will be shown that this notion is idempotent, i.e. the inclusion of other superanticipatory systems into the model of the future does not yield an extended class of systems. Furthermore, most anticipatory networks can be regarded as superanticipatory systems. we will discuss the anticipatory abilities of an autonomous system that go beyond the capabilities attributed usually to artificial consciousness. As an example, in the final part of the paper we will present an application of anticipatory networks to select compromise solutions to multicriteria strategic planning problems applying scenarios of anticipated consequences provided by an IT foresight project. An extension of the model presented in [3] is discussed that could be applied to solve scenario filtering problems that occur in foresight exercises. Another application to be discussed is a coordinated cooperation of autonomous robots that mutually anticipate team members' actions.

Keywords: anticipatory networks, superanticipatory systems, consequences of a decision, causal fields, scenarios, foresight

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