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Research Prototype of the Cognitive Decision Support System for Information Preparation of Decisions of the Complex Task of Monitoring Situations and the State of a Control Object in Systems with a High Spatio-temporal Dynamics

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Nowadays, we can see the cataclysmic expansion of the intellectual capabilities of the human-operator as well as researches of highly dynamic areas of knowledge where it is required to "learn", "understand", "remember", "assess the situation", "find a solution" and "check execution".

Analysis of the trends of the XXI century in the intelligent power engineering convincingly shows that mathematical models should cooperate with the heuristic knowledge and accumulated experience of the human operator in hybrid and synergetic systems complementing the operator's natural cognitive abilities in working with operational-technological information.

A new class of artificial intelligence systems, cognitive functional hybrid intelligent decision support and control systems, is being announced.

An analytical review of the structures of control systems from a simple one without feedback to a cognitive hybrid adaptive control system is presented.

An analytical review of the key ideas of distributed and situational cognition in philosophy, psychology, engineering psychology, neurophysiology, cognitive- and psycholinguistics, control theory, decision-making and cognitive semiotics is given.

The main attention is paid to an interpreter, a two-tier imitation mechanism of complex psychological constructions of an operator. It is a new structural element of cognitive hybrid intelligent control systems. The set-theoretic representations of languages describing the word-verbal and subject-visual tiers are considered, on which a family of correspondences is established. The elements of the latter are specified as signs-concepts that reflect in the semiotic model areas of professional knowledge of the operator and the developer of automatic partners for operational activities. The concepts of "cognitive image of the control object" and "operational image of the control object" are specified on set-theoretic relations. A set of signs-concepts forms a semiotic model of the conceptual sphere of cognitive hybrid intelligent systems. The sign-concept from a semiotic model of the conceptual sphere has conceptual, figurative and pragmatic components. It determines the relevance of the transition to exploitation in the intellectual power engineering of the formula "content of the sign = image + text" with damping of the content of the "cognitive image" into the content of the sign "operational image". The formalism of a cognitive-oriented two-tier model of the operational decision support process is introduced.

Architectural solutions of a cognitive hybrid intelligent system solving the problem of analysis and evaluation of possible emergency situations in electricity grids and its laboratory testing on the materials of a fragment of the district of electrical networks of the regional electric power system are considered.