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Образец для цитирования:

Богомолов А. С. Предотвращение аварийных комбинаций событий при управлении человеко-машинными системами // Изв. Саратов. ун-та. Нов. сер. Сер. Математика. Механика. Информатика. 2019. Т. 19, вып. 2. С. 196–206. DOI: <https://doi.org/10.18500/1816-9791-2019-19-2-196-206>

Prevention of Accidental Combinations of Events in the Control of Human-Machine Systems

A. S. Bogomolov

Aleksey S. Bogomolov, <https://orcid.org/0000-0002-6972-3181>, Institute of Precision Mechanics and Control, RAS, 24 Rabochaya St., Saratov 410028, Russia; Saratov State University, 83 Astrakhanskaya St., Saratov 410012, Russia, alexbogomolov@ya.ru

In the work the problem of accidental combinations of events is investigated. An accidental combination of events is a set of defects in equipment, software and human errors, relatively non-dangerous separately but leading to an accident when they occur in a certain order at a certain time interval. Modern warning tools can parry mainly individual adverse effects and to effectively prevent critical modes it is necessary to provide mathematical analysis of systems for accidental combinations of events at different time intervals. The task of managing the prevention of accidental combinations of events is set as the task of the variational calculus on the conditional extremum. A method for solving the problem based on the analysis of failure trees and ways of successful operation is proposed. The given method allows selecting the minimum set of adverse events, the parrying of which makes it possible to reduce the likelihood of emergency combinations to a safe level. The properties of the paths of successful functioning were determined and proved including accurate estimates for their number which allows ranking tasks by time complexity and increasing the efficiency of their solution. Heuristic approaches were developed which allow to take into account the order of occurrence of events when managing the process of preventing their emergency combinations. The specified sequence of incidents are taken into account by allocating graphs and event aggregation. The obtained results are intended for use in decision support systems at various levels in managing the prevention of critical conditions and accidents of human-machine and organizational systems.

Keywords: combination of events, human-machine system, tree of failures, probability of an accident, way of successful functioning, order of events.

Received: 09.09.2018 / Accepted: 07.10.2018 / Published online: 28.05.2019

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Cite this article as:

Bogomolov A. S. Prevention of Accidental Combinations of Events in the Control of Human-Machine Systems. *Izv. Saratov Univ. (N. S.), Ser. Math. Mech. Inform.*, 2019, vol. 19, iss. 2, pp. 196–206 (in Russian). DOI: <https://doi.org/10.18500/1816-9791-2019-19-2-196-206>
