

Constraint Programming for Cosmonauts Training Problem

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Abstract. A method based on constraint programming is proposed for solving a cosmonauts training problem. Computational results of the implemented method and experiments on real data are presented.

Keywords: operations research, scheduling models, constraint programming

We consider the following cosmonauts training problem (CTP). Each cosmonaut has his own set of tasks which should be performed with respect to resource and time constraints. The problem is to determine start moments for all considered tasks. CTP is a generalization of the resource-constrained project scheduling problem with "time windows". In addition, the investigated problem is extended with restrictions of the following sort. Let us assume that the set of tasks is split into several subsets. It is required to generate a schedule that the operations of one of the subsets are executed at least (or at most) with defined frequency. For details of CTP mathematical model, see Bronnikov et al. (2015). Previously, for solving this problem the authors proposed an approach based on methods of integer linear programming (see Musatova et al. (2016)). However, this approach turned out to be ineffective for high-dimensional problems. A new method based on constraint programming is developed. A comparison of the two approaches is presented.

References

- Bronnikov S., Dolgui A., Lazarev A., Morozov N., Petrov A., Sadykov R., Sologub A., Werner F., Yadrentsev D., Musatova E., Khusnullin N.: Approaches for Planning the ISS Cosmonaut Training. Preprint 12/15, Faculty of mathematics, Otto-von-Guericke-University Magdeburg (2015)
- Musatova E., Lazarev A., Ponomarev K., Yadrentsev D., Bronnikov S., Khusnullin N.: A Mathematical Model for the Astronaut Training Scheduling Problem // IFAC-PapersOnLine. V. 49, N 12, 221-225 (2016)