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AN EVOLUTIONARY ALGORITHM APPROACH TO MULTI-OBJECTIVE SCHEDULING OF SPACE NETWORK COMMUNICATIONS

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ABSTRACT—We describe an evolutionary multi-objective optimization approach to the scheduling problem presented by the NASA's Deep Space Network (DSN). This network is the communications system that supports NASA and other space missions from high earth orbit to the outer planets. Today the DSN consists of a small number of large antennas, but in the future it is expected to incorporate several large arrays of smaller antennas that can be flexibly combined for each spacecraft communication session. Multi-objective techniques for schedule optimization have the attractive advantage of explicitly capturing the constraints and preferences of the missions that use the DSN, as well as those based on system-level considerations, and providing unique insight into trade-offs among competing requirements. We have investigated problem representation issues, objective and constraint formulations, and multi-objective optimization techniques that can be applied to this problem. We describe our initial results using an evolutionary algorithm on an illustrative sample problem (contention for a single antenna), and on a projected 2015 mission set with a three-site, 300 antenna array. The results are very promising, not only for generating initial schedules, but also for resolving conflicts where there is severe resource contention.

Key Words: scheduling; multi-objective optimization; evolutionary algorithms