



基于粒子群算法的劣化桥面铺装多目标组合维护策略优化研究

*彭建新^{1,2}, 邵旭东², 张建仁¹

(1. 长沙理工大学省部共建教育部重点实验室, 长沙, 湖南 410114; 2. 湖南大学桥梁工程研究所, 长沙, 湖南 410082)

PARTICLE SWARM ALGORITHM-BASED MULTI-OBJECTIVE COMBINATIVE OPTIMIZATION OF MAINTENANCE SCENARIOS FOR DETERIORATING WEARING SURFACES

*PENG Jian-xin^{1,2}, SHAO Xu-dong², ZHANG Jian-ren¹

(1. Key Lab of Department of Education and Hunan Province, Changsha University of Science & Technology, Changsha, Hunan 410114, China; 2. Institute of Bridge Engineering, Hunan University, Changsha, Hunan 410082, China)

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摘要 发展了维护导致的间接维护成本改进模型, 基于改进的桥面铺装劣化模型推导了在组合维护策略下其状态指标评估公式, 建立了多目标组合维护优化模型。使用自适应粒子群优化算法, 根据寿命期内维护成本现值最小化和状态指标最大化的原则, 满足性能要求和预算限制约束下, 优化出寿命期内成本和性能都满足要求的维护策略。以劣化水泥混凝土桥面铺装为数值算例, 证明了多目标组合优化技术的可靠性和有效性。研究发现: 合理安排组合维护策略中修补性维护时间可以平衡桥梁维护成本和结构安全性能。

关键词: 劣化桥面铺装 状态指标 粒子群算法 组合维护策略 多目标优化 寿命周期成本分析方法

Abstract: Improved indirect maintenance cost models induced by maintenance action were developed. Based on a modified deterioration model of deteriorating wearing surfaces, a series of computational formulas under combinative maintenance scenario are derived to construct a multi-objective combinative maintenance planning model. The adaptive particle swarm optimization is used to optimize the optimal maintenance scenario by minimization of life-cycle maintenance cost and maximization of the structural performance satisfying the requirements of condition index and investment budget. A numerical example of deteriorating wearing surface is employed to demonstrate the effectiveness and usefulness of the proposed multi-objective maintenance planning optimization model. It is found that reasonable timing planning of time-controlled maintenance interventions can balance the life-cycle maintenance cost and condition level of deteriorating wearing surfaces.

Key words: deteriorating wearing surfaces condition index particle swarm algorithm combinative maintenance scenario multi-objective optimization life-cycle cost analysis method

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地址: 北京清华大学新水利馆114室 邮政编码: 100084

电话: (010)62788648 传真: (010)62788648 电子信箱: gclxbjb@tsinghua.edu.cn

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