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基于FA-NSGA分扭传动系统的均载和轻量化优化设计

Load sharing and lightweight optimization design of torque-split transmission system based on FA-NSGA

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英文关键词:torque-split transmission load sharing coefficient fitness approximation multi-working condition multi-objective optimization gear dynamics

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中文摘要:

以提高均载性能和轻量化为目标对某分扭传动系统进行了多目标优化设计.建立了分扭传动的非线性动力学模型，通过计算不同输入功率和输入转速下的均载系数，衡量分扭传动系统均载性能.以分扭传动系统参数为设计变量，考虑多工况条件，建立了以均载系数和质量最小为目标函数的多目标优化模型.为了提高计算效率，提出了具有适应值预测机制的非支配排序遗传算法（FA-NSGA）.利用3个基准函数对FA-NSGA进行收敛性和有效性的测试.结果表明：FA-NSGA对于3个测试函数均能获得满意的最优解，并且都能减少60%以上的真实适应值计算次数.采用FA-NSGA对实例进行优化求解，在得到的Pareto最优解中选取了一组满意的设计参数，该设计结果与参照方案相比均载系数降低了0.05，分扭传动系统质量减少了3.57kg.

英文摘要:

The load sharing characteristics and lightweight were considered as the objectives, so a multi-objective optimization design of torque-split transmission system was conducted. First of all, a non-linear dynamics model of torque-split transmission system was established. Load sharing coefficients under different powers and speeds were calculated to measure load sharing characteristics of torque-split transmission system. Afterwards, a multi-objective optimization model including minimum load sharing coefficient and mass was developed with the torque-split transmission system parameters selected as design variables, and the effects of different working conditions were taken into consideration. In order to improve the solution efficiency, a modified fitness approximation mechanism non-dominated sorting genetic algorithm (FA-NSGA) was promoted. Three benchmark functions were used to test the convergence and effectiveness of FA-NSGA. The test results show that satisfactory optimal solutions in all three test functions are achieved by using FA-NSGA, and more than 60% of the computation times of real fitness can be reduced at the same time. Finally, a given instance was solved by using FA-NSGA, and the satisfactory design variables were selected from the Pareto optimal solution. Compared with the reference design, the selected one reduces the load sharing coefficient by 0.05, and the mass by 3.57kg at the same time.

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