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基于满意度原理的旋转式分插机构多目标优化设计

Multi-objective optimization design of rotary transplanting mechanism based on satisfactory degree theory

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中文摘要:

针对旋转式行星轮系分插机构运动学优化过程中的多目标、非线性、模糊性等问题，建立了基于满意度原理的运动学多目标优化设计模型。运用模糊数学中的模糊综合评价，对若干组分插机构运动学性能予以量化，并用上述样本对BP网络进行训练，求得满意度映射关系，获得满意度函数，利用精英保留策略的实数编码遗传算法进行优化求解及评价，优化结果为：椭圆齿轮长轴半径a为18.10 mm，椭圆齿轮短长轴之比k为0.988，栽植臂初始安装角α0为-42.56°，行星轮初始安装角δ0为11.56°，机架初始安装角φ0为31.02°，行星轮轴心与秧针尖点连线的距离S为153.79 mm，满意度93.11。优化设计结果表明：该方法不仅提高了设计效率和质量，而且更能反映设计人员和用户的需求。

英文摘要:

Aiming at the multi-objective, nonlinearity and fuzziness of optimization of the rotary transplanting mechanism with planetary gear system, multi-objective optimization model of kinematics parameter was established based on satisfactory theory. Fuzzy comprehensive evaluation was used to quantify the kinematics performance of the transplanting mechanism. BP neural network was trained to build the mapping relationship of satisfactory degree and satisfactory function. Optimal solution and its evaluation were obtained by real-code genetic elitism strategy algorithms as follows: semi-major axis of the elliptic gear a was 18.10 mm; the ratio of semi-minor axis to semi-major axis of the elliptical gear k was 0.988; initial settling angle of the planting arm α0 was -42.56° ; initial settling angle of the planet gear δ0 was11.56° ; initial settling angle of the planet carrier φ0was 31.02° ; the distance between the planet gear and the seedling needle tip S was 153.79 mm; and satisfactory degree was 93.11. The results show that the method can improve the efficiency and quality of design and meet the demand of designers and users further.