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基于铸件热应力及变形的人工神经网络和遗传算法优化方法

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Optimization of Thermal Stress and Deformation of the Casting During Solidification by Neural Network and Genetic Algorithm

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摘要 参考文献 相关文章

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摘要 将神经网络与遗传算法相结合,以有限元分析得到的样本集合作为教师样本,通过神经网络的训练建立设计参数与控制目标的非线性映射关系,并以此代替后续的有限元分析,获得遗传算法求解优化问题迭代中所需的目标函数近似值。以Al-4.5%Cu应力框为例,在分析铸件热应力及变形机理的基础上,对应力杆的高度、宽度和粗细杆截面比、浇注温度、界面换热系数和砂型的预热温度6个参数进行优化,从而有效地控制铸件内部的热应力及变形。优化结果表明:此方法在较少的有限元计算情况下即可获得较好的优化解,与初始设计相比,弯曲变形和热应力分别降低了58.5%和40.6%。

关键词: 应力框 神经网络 遗传算法 热应力 变形

Abstract: An artificial neural network is combined with the genetic algorithm. Based on some specimens given by FEM, a non-linear mapping function between multiple design variables and multiple control objects is constructed with BP neural networks (NN) in order to obtain the approximate objective function values that are necessary in optimum design using genetic algorithms (GA). An example of a frame-shape specimen (Al-4.5%Cu) is provided in the present work. By analyzing the deformation and thermal stress of the casting, an optimization process is performed for six design parameters including the height of the specimen, the width and the area ratio of the two stress bars, initial temperatures of the casting and the sand mould, and the heat-transfer coefficient as well. Results indicate that an improved solution can be obtained using less finite element analyses. Moreover, the deformation and the thermal stress decrease, respectively, by 58.5% and 40.6% compared with the initial design.

Keywords: stress-frame specimen neural network genetic algorithm thermal stress deformation

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