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热工自动控制

重型燃机热力系统动态仿真模型

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摘要
文中采用模块化建模方法开发了燃机热力系统动态仿真模型。利用逐级叠加法建立变几何多级轴流压气机全工况性能预估模型，在此基础上运用一维非稳态微分方程组建立压气机级的仿真模块；通过合理的简化建立以压力和焓为状态参数的微分方程组，反映燃烧室内燃气的动态变化过程；借助流体网络技术，将所要求解的级作为压力节点计算其排气压力，按照级工作原理计算其他状态参数的思路建立透平级仿真模块；结合其他相关仿真模块建立了完整的燃机热力系统实时仿真模型。仿真试验表明所开发的数学模型能够正确反映燃机热力系统的动态特性和全工况运行过程，模型运算稳定可靠，不仅可直接应用于燃气-蒸汽联合循环机组实时仿真系统的开发，还可为燃机控制系统设计与分析提供良好的非线性对象模型。

关键词 燃气轮机 压气机 燃烧室 模型 仿真 算法 动态特性

分类号 TK 472；TP 391

Dynamic Simulation Model for the Heavy Duty Gas Turbine Thermodynamic System

Abstract
By using an modular modeling method, a dynamic simulation model for a gas turbine thermodynamic system was developed. A variable geometry multistage axial-flow compressor performance prediction model was set up by means of the sequential stage-stack technique, and then based on the performance prediction model, a compressor stage simulation module was formulated by using a group of one-dimensional unsteady differential equations. After reasonably simplification, a group of conservation differential equations, regarding the pressure and enthalpy as thermal parameters were used to describe the dynamic behavior of the gas in combustor. The simulation module of the stage of the turbine was built based on the design idea which the stage was considered as the pressure node, the discharge pressure of the stage can be solved according to the fluid network calculation method, and then the other state parameters were also solved in term of the work mechanism of the stage. The complete real-time simulation model of the gas turbine thermodynamic system was built on the basis of above simulation modules and other relevant modules. The simulation tests show that the simulation model can correctly simulate the dynamic characteristic and overall operating process of the gas turbine, the iterative method applied in the models is stable. The dynamic simulation model can be directly used for the combined cycle unit simulator development, and is a good nonlinear object model for the control system design and analysis of the gas turbine.

Key words gas turbine compressor combustor model simulation model algorithm dynamic characteristic

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