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电力系统仿真及分析计算

采用原子分解能量熵的低频振荡主导模式检测方法

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摘要： 针对互联电力系统普遍存在的低频振荡现象，提出一种检测低频振荡主导模式的新方法，来克服以往方法不能准确识别主导模式以及无法自适应揭示振荡模式时变特性的缺点。根据振荡信号特点，选取衰减正弦量模型表示原子库。由功角轨迹，通过原子分解法从原子库中辨识出各模态参数，在辨识过程中计算原子分解能量熵，通过比较能量熵大小识别出低频振荡主导模式。该方法不受系统阶数影响且具备较强的数据处理能力，能揭示各模式间复杂的动态特性和非线性作用，可用于低频振荡在线分析。2个仿真算例结果表明，该方法能准确检测出系统低频振荡的主导模式，所得结果与正规形理论分析结果相同，从而验证了所提方法的正确性和有效性。

关键词： 交流电力系统 原子分解能量熵 低频振荡主导模式 特征值分析 时频分布 正规形理论

A Detection Method for Low Frequency Oscillation Dominant Modes Based on Atomic Decomposition Energy Entropy

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Abstract: For the existence of low frequency oscillation phenomena in the interconnection power systems, a new algorithm for detecting the dominant low frequency oscillation modes was proposed to avoid the disadvantages of previous methods that could not identify the dominant modes accurately and could not adaptively reveal the oscillation modes' time-varying performance. According to oscillation signal characteristics, damped sinusoid model was selected to represent atomic library. Using the power angle trajectory, the modal parameters were identified from the atomic library by atomic decomposition method and atomic decomposition energy entropy was calculated during the identification process. By comparing the energy entropies, the dominant inertial modes were identified. This method, unrestricted from the system order, has a strong ability of data processing and can reveal the complex dynamic characteristics and nonlinear effects among the modes. So the method can be applied to low frequency oscillation on-line analysis. The results of two simulation cases show that this algorithm can accurately detect the dominant modes and the simulation results are identical to that of the normal form theory, and the accuracy and effectiveness of the proposed method were validated.

Keywords: AC power systems atomic decomposition energy entropy low frequency oscillation dominant modes eigenvalue analysis time-frequency distribution normal form theory

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