

可再生能源发电

大型风力发电机组线性二次型高斯最优控制策略

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摘要:

为优化额定风速下变速恒频风力发电机组的运行效能,使风力机既能最大化地捕获风能又能最小化随机风引起的疲劳载荷及功率波动,提出一种基于有效风速估计的自适应增益调度线性二次型高斯(gain schedule linear quadratic Gaussian optimal control, GS-LQG)最优控制策略。该控制策略以扩展Kalman滤波器(extended Kalman filter, EKF)估计出的平均有效风速作为增益调度变量,根据风电机组稳态工作点的变化,自适应调整控制器参数,使得在每个工作点都能实现最优控制。以1.5 MW风电机组作为研究对象,对大范围变化风况激励下,风电机组响应情况进行了仿真研究,结果表明该控制策略可以实现准确的风速估计,并且相对于传统控制策略能够有效缓和传动链上转矩的波动,平滑输出功率,对改善风电的电能质量,延长机组使用寿命具有重要意义。

关键词: 风力发电机组 有效风速估计 扩展Kalman滤波器 线性二次型高斯最优控制 自适应增益调度

Linear Quadratic Gaussian Optimal Control Strategy for Large Wind Turbine

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Abstract:

In order to optimize the operation efficiency of the variable speed constant frequency wind turbine, maximize the energy captured from the wind and minimize the fatigue load and power fluctuations generated by turbulence, a gain-schedule adaptive (linear quadratic Gaussian, LQG) control strategy based on effective wind speed estimation is proposed. In this control strategy the mean effective wind speed is selected as the gain schedule variable. The parameter of the controller can change adaptively according to the wind turbine operation points so that the optimal control can be realized at each operation point. The numerical simulation research of the 1.5 MW wind turbine under variable wind conditions has been carried out. The simulation results show that the proposed control strategy can achieve the estimation of the effective wind speed precisely, alleviate the torque variations of the drive chain and smooth output power which have great significance on the improvement of the power quality and prolonging service life of the facilities.

Keywords: wind power generation unit effective wind speed estimation extended Kalman filter linear quadratic Gaussian optimal control adaptive gain schedule

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