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Design of run to run controller with stochastic metrology delay

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Abstract: Run to run control (RtR) is an effective algorithm for semiconductor manufacturing process. Due to the limitation of measurement methods and cost, it is difficult to measure wafer quality in time (i.e., metrology delay) during the manufacturing process. In general, metrology delay is random and time-varying, which directly deteriorate the performance of RtR controller. To overcome this issue, a novel disturbance estimation integrated into exponentially weighted moving average (EWMA) algorithm is presented in this paper. Firstly, taking the probability of measurement into consideration, the formulation of disturbance estimation with the probability of metrology delay is established. Then, the probability of metrology delay is estimated by expectation maximization (EM) algorithm. Thirdly, the stability is analyzed and the static offset existing in the system is compensated. As a result, an EWMA algorithm resolving the stochastic metrology delay is formed. Finally, the simulation cases demonstrate the effectiveness of the proposed algorithm.

Key words: run-to-run control; metrology delay; EWMA algorithm; EM algorithm

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1 Introduction

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Supported by the National Natural Science Foundation of China (61273142), the Foundation for Six Talents by Jiangsu Province (2012-DZXX-045) and the Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD).

图 12 学习控制轨迹跟踪(3维)

Fig. 12 Learning control trajectory tracking (three dimensional)

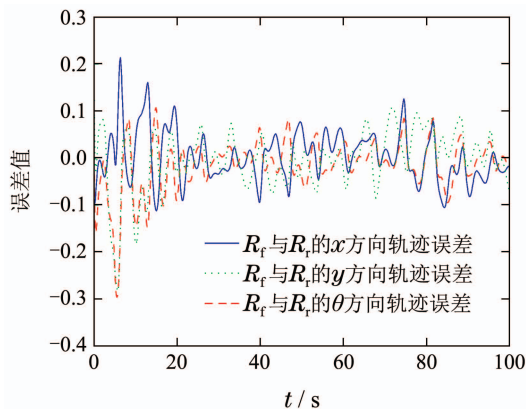


图 13 学习控制姿态跟踪误差

Fig. 13 Learning control posture tracking error

通过上述对比分析两种控制效果,使用了学过知识的RBF NN学习控制器,实现了系统的稳定控制,并节约了资源和改善了性能。

9 结论(Conclusions)

本文针对含未知信息的WMR研究了编队控制,利用RBF NN提出了自适应神经网络控制器和学习控制器,实现了闭环系统的所有信号最终一致有界。由于对回归轨迹满足部分PE条件,在稳定的闭环动态控制过程中RBF NN准确学习到未知闭环系统动态,并且以时不变且空间分布的方式表达和常数权值的方式存储。调用存储的RBF NN常数权值建立的学习控制器中包含已学到的系统未知信息,避免了RBF NN权值的重新训练和更新,实现了系统良好的控制。这在工程实践中能节约软硬件资源,是非常有用的。

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