中国电机工程学报 2012, 32(2) 16-23 DOI: ISSN: 0258-8013 CN: 11-2107/TM

热能工程

锅炉承压管泄漏声传播时间延迟估计

安连锁[1]，王鹏[1]，姜根山[1]，李庚生[2]，沈国清[1]

1．电站设备状态监测与控制教育部重点实验室(华北电力大学)，2．天津国投津能发电有限公司

摘要：

电站锅炉内强背景噪声和炉膛、管道壁面的反射干扰，使声传感器阵列接收到的承压管泄漏声压信号的广义相关函数峰值模糊，甚至无法获得稳定的估计峰值，从而无法精确定位泄漏源位置。采用声场设计软件EASE构建了600 MW超临界锅炉模型，对泄漏声线的传播、衰减等进行追踪，计算出泄漏信噪比；采用系统冲击响应平方反向积分法与Sabine方法对炉膛混响时间进行计算；通过数值实验评估了相位变换(phase transformation，PHAT)、极大似然(maximum likelihood，ML)及改进的噪声条件下的相位变换(phase transform for noise，PTN)以及选择(SWITCH)算法的时间延迟估计性能。结果表明：在强背景噪声和混响存在情况下，SWITCH和PTN算法具有优越性。PTN性能略优于SWITCH算法，但需要泄漏混响与直达声能量比的先验知识，并且需要触发频点检测。

关键词： 炉管泄漏 声线追踪 信噪比 混响 时间延迟估计

Time Delay Estimation for Boiler Tube Leak Sound Propagation

AN Liansuo[1], WANG Peng[1], JIANG Genshan[1], LI Gengsheng[2], SHEN Guoqing[1]

1. Key Laboratory of Condition Monitoring and Control for Power Plant Equipment (North China Electric Power University), Ministry of Education
2. Tianjin SDIC Jinneng Electric Power CO. LTD

Abstract: The interference of strong background noise and reflected by the surface of wall and tube rows in industrial boiler furnace，renders the generalized cross-correlation (GCC) peaks of tube leak sound pressure signals received by sensors array ambiguous, even the stable peak couldn’t be searched at all, which leads to leak position may fail to accurately be fixed. The 600MW supercritical boiler model was established, the leakage source propagation process of reflection and attenuation in boiler furnace was simulated by enhanced acoustic simulator for engineers (EASE), the approximate signal to noise ratio (SNR) was obtained through it; The reverberation time was calculated with the modified Sabine and squared impulse response integration method by the simulation. The time delay estimation algorithm: phase transformation (PHAT), maximum likelihood (ML), phase transform for noise (PTN, derived from PHAT) and SWITCH were evaluated and results revealed the superiority of SWITCH and PTN methods in reverberant and noisy boiler background. Although SWITCH is outperformed by PTN slightly, but the prior knowledge of reverberant energy to direct energy ratio and frequencies onset detection is required in PTN method.

Keywords: boiler tube leak ray tracing signal to noise ratio (SNR) reverberation time delay estimation (TDE)

收稿日期 2011-02-14 修回日期 2011-03-31 网络版发布日期 2012-01-20

DOI:

基金项目:

国家自然科学基金项目(50976034，10974053)；河北省自然科学基金项目(A2011502103)。

通讯作者: 王鹏

作者简介:

作者Email:

参考文献：

本刊中的类似文章

1．沈国清 安连锁 姜根山 梁亚园 张达勋.电站锅炉声学测温中时间延迟估计的仿真研究[J]. 中国电机工程学报,

2007,27(11): 57-61
2. 李天云 李光 杨春玲 张春红.基于自适应随机共振的异步电动机转子断条故障检测[J]. 中国电机工程学报, 2007,27(15): 88-92
3. 王明吉 王瑞雪.利用三角形前向展开法追踪温度梯度场中的声线路径[J]. 中国电机工程学报, 2007,27(5): 29-33
4. 安连锁 王鹏 姜根山 李庚生 沈国清.锅炉承压管泄漏双曲面定位的遗传算法优化[J]. 中国电机工程学报, 2010,30(26): 17-22
