传感技术学报
中国微米纳米技术学会
全国高校传感技术研究会 主办

面向无线传感结构健康监测的压缩感知方法研究

作　者：季赛, 黄丽萍, 孙亚杰

单　位：南京信息工程大学计算机与软件学院

基金项目：江苏省高校自然科学研究计划项目“仿生无线传感器网络中故障诊断与自修复技术的研究”

摘　要：

无线传感器网络在结构健康监测方面有着广泛的应用，但由于该领域的传感器数量和种类众多，数据压缩对系统的高效运行起着关键作用。因此，提出了一种基于压缩感知的无线传感结构健康监测方法，对航空铝板的结构振动信号采用高斯随机矩阵将高维信号序列投影到低维空间，获得稀疏采样的线性测量值，实现信号的压缩采样。研究改进的正交匹配追踪算法来实现稀疏信号的重构。实验结果表明，与已有的无线传感结构健康监测相比，采用压缩采样的监测方法具有良好的抗噪性，并能获得较好的数据压缩效果，节省了网络的带宽和能量；通过信号的近似重构（重构误差在±0.13），能实现航空铝板损伤准确识别（误差0.84mm）。

关键词：无线传感器网络；结构健康监测；损伤识别；压缩感知；稀疏表示；重构误差

The method of compressed sensing in structural health monitoring based on wireless sensor networks

Author's Name:

Institution:

Abstract:

Wireless sensor networks (WSNs) have a wide range of applications in structural health monitoring (SHM), Generally,a substantial number of sensors are required in SHM systems. Data compression has, therefore, a potentially important role in SHM to keep the system running with high efficiency. Therefore, this paper proposes an method of compressed sensing in structural health monitoring based on wireless sensor networks. It provides a new sampling method to reduce data acquisition, which says that sparse or compressible vibration signals of aviation aluminum can be exactly reconstructed from highly incomplete random sets of gaussian measurements matrix. At the same time, the sparse signal reconstruction method based on improved orthogonal matching pursuit algorithm is studied. The experiment results show that, compared with the existing SHM based on WSNs, the proposed method can save the network bandwidth and energy according to a good anti-noise property and a better data compression effect. Through signal reconstruction, whose error is controlled between -0.13 and +0.13, the damage of aviation aluminum plate is detected accurately and the detection error is only 8.4 mm.

Keywords: compressed sensing (CS)；wireless sensor networks (WSNs)；structural health monitoring (SHM)；damage identification；sparse representation；reconstruction error

投稿时间：**2013-09-23**

查看pdf文件