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Online adaptive distributed control of vibro-acoustic systems

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One of the primary difficulties in distributed, real-time vibro-acoustic control is the difficulty of high-bandwidth network communication of sensor data. The necessary communications rate has proven overwhelming to existing communications protocols. In order to overcome this limitations an adaptive control technique has been developed that requires only occasional inter-node communication of sensor data in order to maintain optimal performance. The technique is based on iterative feedback tuning (IFT) which has the advantage of not requiring a system model. In this system, each control node collects its sensor data over a period of time. The data is then communicated to other nodes in the system. Once a node has received the required sensor data the local adaptation algorithm is initiated. Local feedback gains are adjusted based on an estimate of the cost function gradient and the new control law is implemented until the next adaptation cycle. This work presents the theory behind this adaptive control technique and simulation results of the control performance are presented. It is demonstrated that this approach to distributed control can perform as well as model based optimal distributed control, and nearly as well as centralized control.