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Industrial applications of acoustic pulse reflectometry

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Acoustic Pulse Reflectometry (APR) has been used extensively in the study of wind instruments, for measuring input impedance, bore reconstruction, and fault detection. Industrial applications have often been mentioned in the literature, though they have barely been exploited. Academic APR systems are extremely bulky, which limits their industrial use severely. Two requirements from such an industrial system are that the source tubes be as short as possible, and that they be able to measure long objects, often much longer than most musical instruments, e.g. condenser tubes which are at least 8 meters long. This creates difficult calibration problems and difficulties in obtaining sufficient SNR levels, especially at low frequencies. In this paper we describe a system with the necessary adaptations for industrial use. We demonstrate the problems that are encountered, and introduce solutions which we have implemented. Modifications to the deconvolution phase improve low frequency SNR, which is further improved using nonlinear filtering. Adaptive filters are then used to discriminate between a faulty and intact system. When faults are detected, they are identified using several identification algorithms based on matched filtering and local inverse scattering.