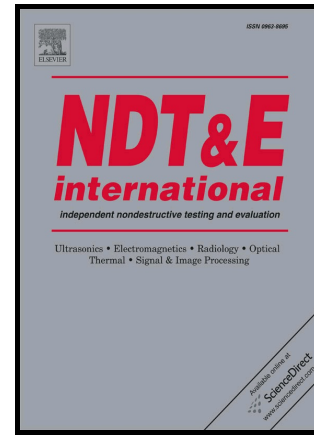


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# Phased array ultrasonic signal compressive detection in Low-Pressure Turbine Disc

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## Abstract

As the core component of nuclear units, the inspection of Low-pressure (LP) turbine disc is of particular importance to assure their quality and safety. Nevertheless, the complex structure makes the position of transducer very limited and the huge size brings about a significant amount of data. Recently, it has been suggested that compressive sensing (CS) may be promising to implement the sampling far below the Nyquist rate. In this work, a novel CS-based procedure specifically dedicated to phased array ultrasonic signals in LP turbine disc NDE is proposed, aiming to achieve high compression rate with low signal distortion. Taking the effect of sampling frequency into account, the simulation is first conducted on the signals derived from CIVA platform. An excellent recovery is reached using measurement points less than the Nyquist sampling limitation required, which confirms the miraculous power of the CS. Then experimental verification is presented on a proportional mockup with EDM notches and the reconstruction performance is compared between five greedy algorithms, like used in the simulation. Although not as impressive as the results obtained from simulated data, the Orthogonal Matching Pursuit (OMP) algorithm verifies its feasibility and effectivity in ultrasonic array signal compression with sufficient recovery accuracy. Finally, the performance of OMP-based CS is compared with the gold standard for signal compression, namely, the discrete wavelet transform (DWT).

**Keywords** Low-pressure turbine disc; Phased array ultrasonic; Compressive sensing; CIVA simulation

## 1. Introduction

Low-pressure (LP) turbine disc failure can have catastrophic consequences. Since its first

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