

# HIGHSPEED TURBOCHARGER INSTABILITY

**R. Gordon Kirk**

Professor

**Alan A. Kornhauser**

Associate Professor

**John Sterling**

Graduate Research Assistant

**Ali Alsaeed**

Graduate Research Assistant

Mechanical Engineering Department  
Virginia Polytechnic Institute and State University  
Blacksburg, VA 24061 USA

## ABSTRACT

Automotive turbochargers are known to have operation into the self-excited unstable region. The operation in the nonlinear limit cycle has been tolerated on most applications to date. The automotive turbocharger presents a challenge for normal rotating machinery data acquisition systems. This paper reviews a current on-engine test stand capability being developed at Virginia Tech as part of a recent senior capstone design project. The development of the diesel engine test stand and the associated data acquisition system will be discussed. The results will show that it is possible to document the high speed vibration and instability of the stock turbocharger. Vibration spectrum content clearly identifies the shaft instabilities and provides the basis for additional evaluation of future bearing design modifications. Future research will be devoted to the elimination of the large sub-synchronous excitation.

Keywords: stability, turbocharger, fluid-film bearings, experimental testing