

## **Abstract.**

One of the strategies to meet the trend to improve efficiency, reduce emissions, increase specific power and reduce the volume of internal combustion engines is the air boost using turbochargers.

Due to the high demands and operational performance of centrifugal turbochargers used in automotive engines is necessary to improve the knowledge of the operating limits through experimental and theoretical tools, in order to predict and understand the physics behind this phenomena related with failures on the turbochargers.

Two techniques for measuring the movement of the shaft were developed in order to analyze the behavior of the turbochargers in typical failures. These techniques are originals related to the information that each one can provide. The first technique is based on the analysis of images, this technique can visualize the events during turbo failure and this technique can provide the area where the shaft has been moving. The second technique developed can provide the information of the instantaneous position of the shaft movement using infrared sensors. Tests related to typical failures of the turbochargers have been raised and in these tests the shaft motion and different thermodynamic variables have been measured. The measurement techniques and the theoretical basis of the literature review have allowed the identification of the different excitations that can generate instabilities in the turbo shaft movement and the most sensitive points that trigger processes of the turbocharger failure.

An approximate model of the film hydrodynamic lubrication through the different methods have been estimated and an analysis of the limitations of these methods and the differences between coefficients depending on the method used have been estimated. The linear coefficients of the lubricating film have been used in a linear rotational dynamics model to identify critical points of operation and the different modes of vibration of the rotor.

Finally, as part of the conclusions, the motion excitation sources were identified; limits for the shaft movement and limits of different operating conditions were established; some of the turbochargers failure mechanisms that can help to carry out inspections were established; and the critical points of operation of one of the turbochargers were analyzed using a linear model.