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A methodology for cracks identification in large crankshafts

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ABSTRACT

Diesel engines used in power plants and marine propulsion are especially sensitive to outage events. Any advance in the early detection of failure will increase the reliability of the electricity supply and improve its productivity by reducing costly power outages. Fault detection and diagnosis is important technology in condition-based maintenance for diesel engines. This article presents a classifier based on neural networks for identifying failure risk level in crankshafts, the engine component of greatest cost concern. The authors have developed a finite element model for crack growth that fits well with fracture appearance and produces the evolution of crankshaft stiffness with crack depth. A lumped system model of the engine uses this evolution as input, giving the instantaneous speed at the engine flywheel as a function of crack depth. All the results shown in the paper come from outputs of the simulation models which have been built from real engine data. Measurements of the instantaneous flywheel speed were not available due to the crankshaft failure. All data are extracted from this speed and are then classified using a Radial Basis Function neural network.

1. Introduction

Diesel engines are commonly used in power plants all around the world, particularly for on-site power generation in special locations such as islands, which are not connected to a mainland electrical grid. This kind of power plant is especially sensitive to outage events. Any advance in the early detection of failure will increase the reliability of the electricity supply and will improve its productivity by reducing costly power outages.

This is of particular interest in order to detect problems related to the engine crankshaft. In the case of crankshaft failure, repair costs include not only that of the crankshaft itself, but the cost of other parts of the engine that can be affected by crankshaft failure, such as connecting rods, pistons and cylinders, must be added. In addition, the length of time required for repairs has to be taken into account, mainly because of the crankshaft location inside the engine. This greatly increases the total repair cost.

Several reliability, availability and maintainability (RAM) studies of diesel generators have been conducted and in some of them [1], statistics on availability, failure cause, mean time between forced outages and so on have been shown. In relation to diesel engines, Arinc Research Corporation conducted a study for the US Army Engineering and Housing Support Centre (EHSC) [2] that showed results from diesel engines up to 2 MW. This study included a detailed classification of the parts involved in the failure of this power range and it revealed that, even though the failures per year related to engine crankshaft were low (0.02), it resulted in a higher mean time to perform corrective maintenance

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