Chapter 111
Remote Fault Diagnosis System for Marine Power Machinery System

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ABSTRACT

Marine power machinery parts are key equipments in ships. Ships always work in rigorous conditions such as offshore, heavy load, et cetera. Therefore, the failures in marine power machinery would badly threaten the safety of voyages. Keeping marine power machineries running reliably is the guarantee of voyage safety. For the condition monitoring and fault diagnosis of marine power machinery system, this study established the systemic condition identification approach for the tribo-system of marine power machinery and developed integrated diagnosis method by combining on-line and off-line ways for marine power machinery. Lastly, the remote fault diagnosis system was developed for practical application in marine power machinery, which consists of monitoring system in the ship, diagnosis system in laboratory centre, and maintenance management & maintenance decision support system.

INTRODUCTION

Marine power machinery systems provide power supply for ships. Any failures in the system may induce terrible marine accidents. Hence, the normal operation of the marine power machinery system is essential for a safe trip. However, exposed to hostile environment, the marine power machinery systems are readily to break down (Jones & Li, 2000; Yan, 2005a; Li, Z., 2010a, 2011a & 2011b; Li, W. 2001). It is therefore imperative to diagnose impending faults of marine power machinery systems to prevent malfunctions.

Machinery condition monitoring and fault diagnosis (CMFD) technique initially emerged at the end of 1960s, and the research work published in the journal of Automatica can be regarded as the milestone of CMFD (Mehra & Peschon, 1971), which led to a series of scientific and industrial activities in the field of large-scale machinery and equipment condition monitoring projects. As for the field of marine engineering, the marine industry over the world has made strict instructions for the CMFD of marine power machinery. American Bureau of Shipping (ABS) has drafted the "Test Guide of Preventive Maintenance" in 1987 (An aligned, 2006; Leontopoulos, 2005; Low & Lim, 2004). Det Norske Veritas (DNV) has emphasized the CMFD of main engine and shaft line in their "Test Handbook of marine main engine and shaft line" (An aligned, 2006; Leontopoulos, 2005; Low & Lim, 2004). Nippon Kaiji Kyokai (NK) has developed new CMFD technologies for the marine power machinery (An aligned, 2006; Leontopoulos, 2005; Low & Lim, 2004). China Classification Society (CCS) has compiled the "Guide of Diesel Engine grease condition monitoring" and "Guide of Propeller condition monitoring". Benefited from decades of development, numerous CMFD methodologies have been put forward. These methods can be divided into several major categories, such as the performance parameter monitoring, vibration analysis, oil analysis, and instantaneous speed monitoring etc. The information flow for machinery and equipment condition monitoring is shown in Figure 1 (Liu & Yan, 2010). The performance parameter monitoring is usually used to warn of abnormal operation of the machines under the condition that the concerned specific parameters (such as the temperature, pressure, etc.) have exceeded the 'baseline'. The oil analysis has been now used for marine equipment condition monitoring and fault diagnosis, and the commercial services have already been provided by the Mobil Oil Company and Lloyd's Register. It mainly concerns the geometrical characteristics and chemical characteristics of the wear particles in the lubricant. As for the vibration analysis and the instantaneous speed monitoring, they are the most used and simplest methods for the CMFD of marines. The recent advancements on the smart sensor technique and signal processing have made the vibration analysis and the instantaneous speed monitoring very efficient and easy to realize for industrial application.

Although many fault diagnostic methods have been developed and proven to be effective in laboratory for the condition monitoring and fault diagnosis of marine power machinery systems,

Figure 1. The information flow for marine machinery and equipment using CMFD technique (Liu & Yan, 2010)
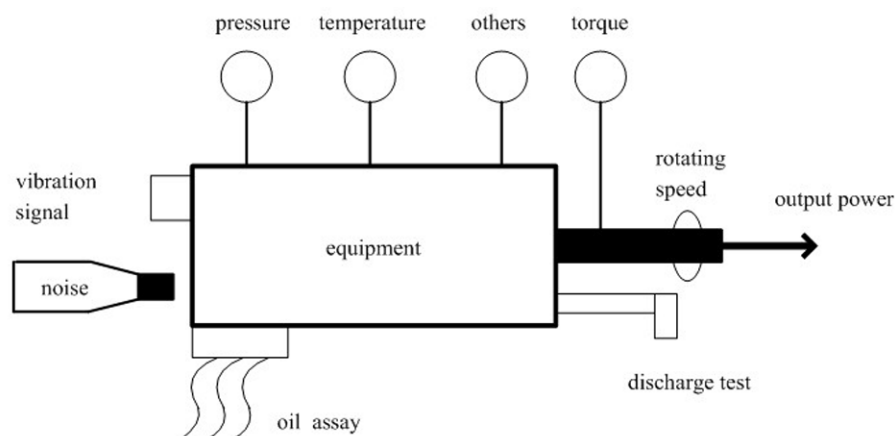
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