Extracting Electromechanical Signals for Icebreaker Insights

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Nonintrusive load monitoring has a proven track record of providing benefits for equipment operation logging, fault detection and diagnostics, condition-based maintenance, and energy scorekeeping. A nonintrusive load monitor (NILM) can measure the aggregate of electromechanical signals at a central utility point and extract individual loads from this power stream. Segregating and identifying these unique electrical signatures from various shipboard machinery components allow a NILM to assess the health of equipment and predict potential failures before they are evident through traditional monitoring methods. NILMs have been installed on multiple US Coast Guard and US Navy vessels over the past several years, collecting vital data that has rapidly accelerated the monitoring capabilities of this technology. This work specifically expands upon the previous successes and applies the same concepts of fault detection and equipment diagnostics to a 140 ft US Coast Guard icebreaking tug, USCGC THUNDER BAY. The NILMs installed on THUNDER BAY are capable of directly monitoring the electric propulsion drive, which coupled with its unique icebreaking mission allow the NILM to gain crucial insights into ship operation that have not been previously available. Additional improvements were developed for the NILM's software and hardware components to incorporate an added wireless capability, allowing the NILM to act as a central processor for a physically securable network of wireless sensing nodes. Testing was conducted in four separate shipboard environments to confirm the feasibility of this network architecture. Specific methods for implementing this sensor network are discussed, and techniques for combining both power and vibration measurements are presented to identify insights that were previously unattainable through power monitoring alone.

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