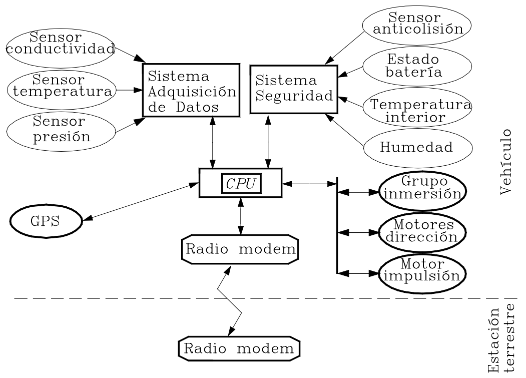

Fig. 3. Diagram of the autonomous control.

Once was verified the correct operation of all vehicle systems, in phase of manual control, we began the field work. The tests were made in a swimming pool of 25m of length, 15m of width and 2 meters of depth. The first time when the vehicle was placed into the water, see figure 4, a perfect balance adjustement was necessary. It was obtained incorporating a ballast in prow of 3.6kg and a push in stern of 1.5kg. This situation allowed the beginning of the immersion and navigation tests. In the navigation test the speed was approximadly 1,5m/s with the control of the propulsion motor at 80% of full power. The course variation is obtained very easily using the lateral motors to full power and decreasing the propulsion of the first engine. The operation of immersion was done with complete normality acting on the group motor-cylinder. Navigation in depth was successful, maintaining the course of the vehicle with good stability, direction and depth.

3. Conclusions.

The success of the vehicle test in manual control will accelerate the phase of autonomous control. The result, at this moment, is that we have a robust platform, of dimensions (1885 mm in length and 320 mm of diameter) and weight (76 kg) which is nonexcessive and it

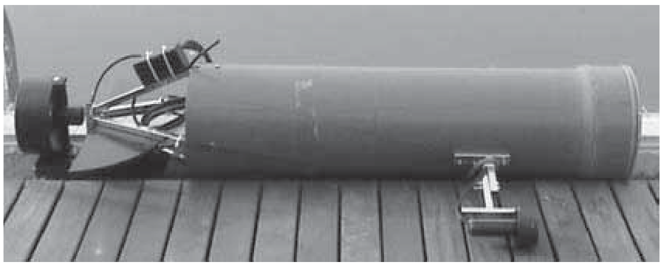

Fig. 4. Constructed vehicle.

facilitates its manageability and operativity and that we waited for behavior of remarkable form in the open sea. The autonomy of the system on the basis of NiCd batteries was poor in these first tests. It will be increased with the use of Lithium Ion Polymer cells (Lipo), once the autonomous check tests begin into the open sea. With this improvement an autonomy of 10 running hours to a regime of 60% of power of main motor is considered. As a final valuation, we can say that a low cost oceanic platform of observation has been developed which is able to navigate by the surface of the sea and makes vertical immersions to obtain water column profiles. A registry system and independent storage of high-resolution data have been developed and, finally, different ways have been studied to control dynamic nonlinear such as FPIC (Fixed Point Induced Control) and TDAS (Time-Delay AutoSynchronization).

4. References

[1] S. Desset , R. Damus, F. Hover, J. Morash, V. Polidoro. Closer to Deep Underwater Science with ODYSSEY IV Class Hovering Autonomous Underwater Vehicle (HAUV). Autonomous Underwater Vehicle Laboratory at the Massachusetts Institute of Technology.

[2] Embedded Communication System for an Autonomous Underwater Vehicle. University of Victoria. Faculty of Engineering. Fall 2002 Work Term Repor. British Columbia,

[3] Pascoal, A.; Oliveira, P.; Silvestre, C.; Bjerrum, A.; Ishoy, A.; Pignon, J.-P.; Ayela, G.; Petzelt, C. "MARIUS: an autonomous underwater vehicle for coastal oceanography". Robotics & Automation Magazine, IEEE. Volume 4, Issue 4, Dec. 1997 Page(s):46 - 59

VIBRATION ANALYSIS AND DIAGNOSTIC IN A CATAMARAN VESSEL

E.Egusquiza, X. Escaler, C. Valero, M. Coussirat

Center for Industrial Diagnostics (CDIF)-UPC; Av Diagonal, 647; 08028 Barcelona (Spain).
Phone +34-93-4016714; Fax +34-93-4015812; email: egusquiza@mf.upc.edu

KeyWords –Vibration, cracks, diagnostics, Catamaran vessel

1. Introduction

In this paper the measurement and analysis of vibrations in a catamaran vessel is presented. The analysis was aimed to detect the cause of the structural damage that appears in the vesselduring its operation. Cracks appeared in sterntubenext to inlet duct and in hull next to sea water discharge pipe.

The vessel had four water jet pumps, two on each side, powered by variable speed internal combustion engines. The impeller takes sea water through an inlet duct in the bottom of the vessel and creates an output water jet that propels the unit [1][2]. A deflector behind each jet serves to control the vessel operation.

This analysis was used in the litigation that the owner of the vessel put against the constructor [3].

2. Experimental measurement

A series of vibration and pressure measurements on the vessel were carried out. The goal of the measurements was to determine possible harmful levels that could be the origin for the appearance of cracks and failures in the mechanical parts of the propulsion system.
Vibration and pressure measurements were carried with the vessel standing still and sailing at different operating speeds with sea in calm conditions. The vessel was operated with the clutch off at an engine rotating speed of 500 rpm and with the clutch on at the same speed. Then, engine speed was increased and readings were taken at around 1000, 1200, 1500 and 2000 rpm's. Start-up and coast down transients were also recorded.

The overall vibration levels and vibration signatures were calculated.

3. Results and Discussion

The vibration signals were analysed using several methods from spectral analysis to transfer functions between structure and fluid-flow (Fig. 3).

The different phenomena that could produce excitation forces on the structure were identified and studied [4]. The most important were the rotor-stator interaction, the cavitation and the turbulence generated by the operation of the pump [5][6]. The structural response was also analysed.

The origin of vibrations was determined. Vibrations in water jet room were due to the -Centrifugal pump Internal combustion engine IC

Fig. 1. Picture of the catamaran vessel.

pressure pulsation generated by the pump. Vibrations at stern tube and duct were increased by a natural frequency in the range from 30 to 60 Hz. Another resonance could be observed around 100 Hz. This was confirmed by the transient analysis.

Vibrations in the engine room vibrations were produced by the internal combustion engine. In the water jet room, the highest vibration levels were found in stern tube, inlet duct and in the pump shaft bearing near the coupling.

The severity discussed by comparing the measured vibrations with the general Standard ISO/DIS 10816-3, as well as other marine guidelines [7].

The possible remedies are also discussed.

4. Conclusions

The analysis was able to identify the origin of vibrations generated by the pump the gear box and the internal combustion engine. Some critical operating conditions that could damage some parts of the vessel structure were identified.

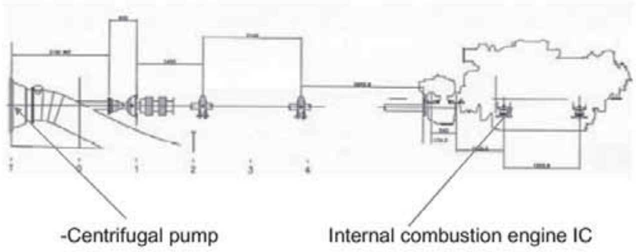

Fig. 2. Water jet room and engine room.

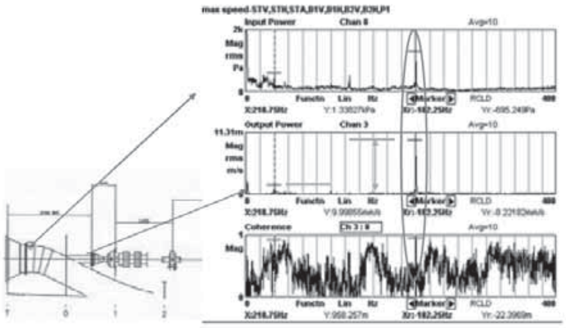

Fig. 3. Coherence between pressure pulsations and vibrations.

5. References

[1]Park, W. G., Yun, H. S., Chun, H. H., Kim, M. C., 2005. Numerical flow simulation of flush intake duct of waterjet. Ocean Engineering 32, 2107.
[2] Allison, J., 1993. Marine waterjet propulsion. SNAME transactions 101, 275
[3] E. Egusquiza, X. Escaler "Mark1 vibration analysis report".
[4]Kim, M. C., Chun, H. H., 2006. Experimental investigation into the performance of the axial-flow-type waterjet according to the variation of impeller tip clearance. Ocean Engineering in press.
[5] C. Rodriguez, E. Egusquiza, I.Santos "Frequencies in the Vibration Induced by the Rotor-Stator Interaction in a Pump-Turbine" Journal of Fluids Engineering, ASME, Accepted to be published (November 2007)
[6] X. Escaler, E. Egusquiza, M. Farhat, F. Avellan, M. Coussirat. "Detection of cavitation in hydraulic turbines" Mechanical Systems and Signal Processing, Vol. 20/4 (2006) pp 983-1007
[7] ISO Standards.

MARINE OIL MONITORIZATION BY MEANS OF ON-LINE SENSORS

E. Gorritxategi (1), A. Arnaiz (1), J. Bellew (2)
Fundación TEKNIKER – Avda. Otaola 20 – 20600 Eibar (Spain)
(+34)943206744 egorritxategi@tekniker.es
Martechnic GmbH- Adlerhorst 4 - 22459 Hamburg (Germany)

1. Introduction

The degradation and contamination of lubricating oil is the root cause of many severe machine failures. It also reduces equipment service life and frequently leads to unnecessary maintenance expense. This is true in all situations where machinery is deployed however, in the maritime environment the situation is exacerbated for all of the reasons we know so well. Lube oil is a critical fluid onboard ship. It is the lifeblood of propulsion and power generating engines and any quality failure leaves the vessel, its cargo, the community onboard and even the environment at the mercy of the most hostile operating condition on earth. Precise analysis of engine lube oil can only be performed in shore-based laboratories and the logistics of the maritime industry leaves operators with unreasonable extended periods between analyses. Over the intervening years field tests for basic lube oil parameters have been developed in an attempt to bridge this vulnerability gap.

This problem has been recognised as a critical area of vulnerability by operating engineers, engine manufacturers and standard setting bodies for around 20 years. Unfortunately, no adequate solutions were available and existing technology was unable to respond to the challenge. In recent times the increasing demand for machine lifetime reliability and unmanned classification exposed this deficiency and the rising cost of lubrication and environment sensitivity regarding spent lube oil disposal exacerbated the situation. In spite of this

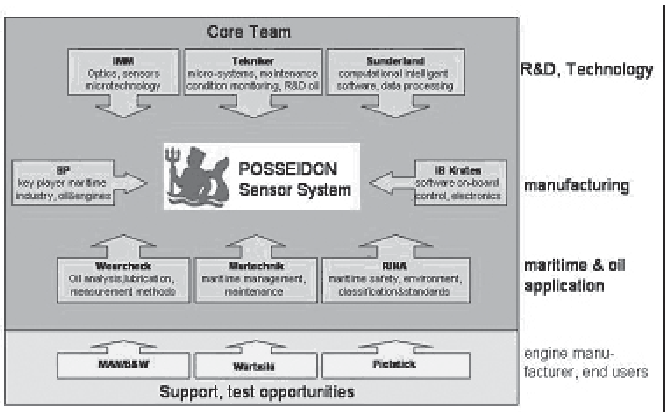

Figure 1. POSSEIDON Consortium.