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Design and performance analysis of B-series propeller for traditional purse seine boat in the North coastal region of central Java Indonesia

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Abstract

In the North Coastal Region of Central Java , the traditional fishing boat is a primary object that generates the economics activities of the social community. As an artisanal fishery, the boats generally adopt the tradition to build technique from their predecessor. Therefore the lack of practice to determine the propeller design which considered the hydrodynamic relation within the boat dimension, hull form geometry and propeller is observed. Presently, there is no a standard propeller design that particularly well designed considering the hull shape geometry for the traditional boat . The aim of the research is to identify the propeller that would be applied to the fishing boats typically found in the North Coastal Region of Central Java using B-Series marine propeller . Computational Fluid Dynamics (CFD) analysis for assessing the performance ofthrust and torque of the developed propeller was performed.

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DESIGN AND PERFORMANCE ANALYSIS OF B-SERIES PROPELLER FOR TRADITIONAL PURSE SEINE BOAT IN THE NORTH COASTAL REGION OF CENTRAL JAVA INDONESIA

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In the North Coastal Region of Central Java, the traditional fishing boat is a primary object that generates the economics activities of the social community. As an artisanal fishery, the boats generally adopt the tradition to build technique from their predecessor. Therefore the lack of practice to determine the propeller design which considered the hydrodynamic relation within the boat dimension, hull form geometry and propeller is observed. Presently, there is no a standard propeller design that particularly well designed considering the hull shape geometry for the traditional boat. The aim of the research is to identify the propeller that would be applied to the fishing boats typically found in the North Coastal Region of Central Java using B-Series marine propeller. Computational Fluid Dynamics (CFD) analysis for assessing the performance ofthrust and torque of the developed propeller was performed.

Key words: Wageningen B-series propeller; Traditional purse seine boat; Thrust propeller; Propeller efficiency

INTRODUCTION

The North Coastal of Central Java is the second largest fishery community region in Indonesia. More than 200.000 peoples have a livelihood as fishermen, and others have jobs related to the fishing industry such as fishing port and boatyard. Therefore the central java has a large number of fishing boat fleet that is about 8000 boats to support the fishing activities of them, [1]. The traditional fishing boats generally constructed by boat builders and boat yards that are located on the coastal region. Most of the boat builders use their own skill that is adopted from the tradition to build technique of their predecessors.Although they do not have any knowledge of basic principle of naval architecture and marine engineering, the boat building technique allow them to create a robust boats for their fishing region. However it is observed that there is a problem of the lack of practice to determine the propeller design which considered the hydrodynamic relation within the boat dimension, hull form geometry and propeller.Therefore, in order to improve propulsion efficiency of this type of boats, contemporary engineering methods should be applied.

The process of propeller design is a complex procedure where the viscous flow around the propeller and the cavitation effect should be considered[2], [3]. Propeller design process is also constrained by some hydrodynamics parameters such as Reynolds number, and maximum diameter in the case of weight loading,[4].Since water density is larger than air,therefore the ability to generate the lift force for thrust on the unit of blade area is also limited. Whiletheoretical method offer consistently precision of the design of propeller, however it is quitedifficult to develop, [5], [6].

During the design phase, some critical parameters such as rake, skew, and pitch angles should be determined. Small magnitude of rake might reduce the drag force on the blade surface and increase the thrust force and the propeller efficiency, [7]. The formation of skews providesstability, however, the vibration of propulsion system might be occurred due to the low magnitude of skew angle. Pitch angle is a helix angle of the rotating propeller that influences the magnitude of propeller pitch. Pitch is the axial distance made by a propeller in a complete spin of 360 degrees, at zero thrust and zero slip. The increase of pitch, to the same propeller diameter, might reduce the interaction area with inflow fluid, however it mightincrease the face interaction to the rotational motion, [8]. The large blade area will increase the sweeping area of the water surface. Besides,the increase of blade area may cause higher torque,[9],and reduces the efficiency of the peak performance, [10].

Nowadays new marine propellers designs are created with the application of computational fluid dynamics (CFD) analysis. In the CFD Analysis, Navier-Stokes equation is adopted to solve the nonlinear flow of the marine propeller. Some studies of CFD application on the marine propeller can be found. Shotaro, U., studied on the application of CFD to the computation of the flow around a marine propeller , [11]. A marine propeller model is developed using Implicit Geometrical Method. The results show a good agreement for chord wise load distribution, thrust and torque coefficient with Lifting Surface Method, [11].Watanabe, T., investigate the thrust and torque coefficient using Reynolds Averaged Navier-Stokes (RANS) simulations of flow on the two different conventional propellers and the RANS approach have a good agreement with experimental measurement,[12].

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MODIFIED WIENER–HOPF EQUATION IN IDENTIFICATION PROBLEMS

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The method of adaptive filtration in the tasks of flow settings of cosmic radiation recovery by the measured data for the use in cosmic transport systems with a long life cycle was shown in the article. Optimization mathematic model and algorithm of non-stationary control systems, in which the measurement is made against the background of the noise, are described. Parametric optimization algorithms are done by the use of modified Wiener-Hopf equation and function of sensitivity.

Key words: Algorithm, Optimization, Condition, Operator, Wiener-Hopf

INTRODUCTION

THE PROBLEM OF THE NON-STATIONARY OBJECT IDENTIFICATION

Optimality conditions

It is proposed to consider the construction of the basic design of non-stationary control systems optimization algorithms, whose state measurement is performed against a background of interference [1, 2, 3]. The concept developed in the process of optimization algorithms construction can be used to solve a wide range of problems - from the identification system construction and the solution of filtering non-stationary processes tasks to the construction of parametric control algorithms for non-stationary objects.

For definiteness, let the object be described by an ordinary differential equation

$$\frac{d}{dt}x(t) = f(x,u,w,t), \quad x(t_0) = x_0, \tag{1.1}$$

and measuring its state

$$y(t)=C_x(t)+n(t), \tag{1.2}$$

where $x \epsilon R^n$, $y \epsilon R^m$, $n \geq m$, w(t) and $n(t)$ - Gaussian noise; where as $E[w(t)]=0, E[n(t)]=0$,

E - sign of expectation and

$$E\left[\begin{pmatrix} w(t) \\ n(t) \end{pmatrix} (w^T(\tau) n^T(\tau))\right] = \begin{pmatrix} W(t) & \Pi(t) \\ \Pi^T(t) & N(t) \end{pmatrix} \delta(t-\tau),$$

$\delta(t-\tau)$ - Dirac function, ^{T} – transpose sign.

Note that change in time in the vector-function $f(x,u,w,t)$ occurs as a result of the fact that the parameters of this vector-function are under the influence of external perturbations. i.e. $f(x,u,w,t)=f(x,u,w,\eta(t))$, where $\eta(t)$ - the object parameters that vary according to an unknown law, and, whereas

$$\|\eta(t)\| \leq \mathrm{H} = \text{const} > 0,$$

$$\left|\frac{d}{dt}\eta(t)\right| \leq \Lambda = \text{const} > 0, \quad t \geq t_0.$$

Let

$$\varepsilon(t) = \mathrm{L}(t)x(t) - \Psi(t)\hat{x}(t) \tag{1.3}$$

where $\hat{x}(t) \in \mathrm{R}^q$ - process estimation - solution of the differential equation.

$$\frac{d}{dt}\hat{x}(t) = f_m(y,u,\alpha(t)), \quad \hat{x}(t_0) = \hat{x}_0, \tag{1.4}$$

$\varepsilon(t) \epsilon R^k$ - observation error, $L \epsilon R$, $\psi \epsilon R$ - linear operators that transform $R^n \to R^k$ and $R^q \to R^k$ correspondently, $\alpha \epsilon R^l$ - vector of model optimization parameters. Suppose that the function twice differentiable with respect to $\alpha(t)$.

It should be noted that the step of model structure choice is extremely responsible. The appropriateness, applicability and effectiveness of the evaluation design essentially depend on the reliability with which the mathematical model describes the actual situation (object, measurements, and external parametric disturbances). In most practical problems, a complete, accurate model is not available at all, and its construction has great difficulties, and therefore the problem of evaluation design for the measured process $y(t)$ must be solved with incomplete knowledge of the model. Even more complicated is the problem, when the noise $w(t)$ and $n(t)$ and/or the object parameters (2.1) change in an uncontrolled manner.

In addition, stochastic object state determination described by nonlinear differential equations, from measurements of its phase components against a noise background, requires the solutions of nonlinear differential equations. Moreover, the exact construction, for example, of a nonlinear filter is impossible and, what is

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DETERMINATION OF HEAVY MACHINES PERFORMANCES BY USING A MEASURING SYSTEM WITH TELEMETRIC SYNCHRONIZATION AND TRANSMISSION OF SIGNALS

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This paper presents the investigation of importancefor determining the dynamic structural response of heavy lifting machines subjected to extreme external effects. A measuring system for the experimental investigation of the dynamics of heavy lifting machines is proposed.It shows the experimental testing results of carrying structures for several classes of hoisting and an export mining machine. The results refer to the most important dynamic parameters. The dynamic parameters also include the duration of transient phenomena in handling lifting structures and structural damping.A technical solution based on the measuring chain that is integrated into the mining export plant information system was developed in the research. The recommendation to choose optimal measuring equipment for this kind of measurement is given to manufacturers and users on the basis of the experience gained in the design and implementation of specific measuring systems. The technical specification of amplifiers and transducers that should be developed for this kind of measurement is also proposed.

Key words: Dynamics; Lifting; Machine; Measuring; Structure

INTRODUCTION

Large lifting machines, such as cranes and export mining machinery, are particularly interesting for dynamics research in situations close to incidents, which are often caused by external effects or irregular handling. Experimental testing of these machines is necessary, very complex and risky. Crash tests are not usually the subject of experimental research because of the high cost of this kind of experiment. Therefore, the experience of previous experimental investigations is applied in designing machines. These experiences refer to the values of characteristic dynamic parameters that determine the structure behaviour, and whose applications in mechanical models ensure a faithful simulation of the behaviour without performing an experiment or destroying the structure itself.Experimental investigations into these machines usually have two basic goals: dynamic behaviour analysis under the influence of extreme external effects and verification of dynamic models developed for numerical simulation research purposes.From the research point of view, the legitimate question certainly is: "Is it possible to design a universal measurement system for experimental testing of the characteristic parameters of the largest number of transport machines?" In case of a positive answer one can pose another question: "What should such a measuring kit contain?" In addition to researchers, manufacturers of measuring equipment also want to know this. This paper is a contribution to the answers to the above questions.

STRUCTURE OF THE IMPLEMENTED MEASURING SYSTEMS

The measurements shown in this paper were carried out on a number of lifting machines according to various scenarios that simulate extreme dynamic effects. On the basis of the performed experiments, the criteria of the design of measuring systems were formulated for determining the most important dynamic parameters in transient operating regimes of cranes, auto-cranes and export mining machines. Figure 1 shows a universal measurement scheme for the measurement of cranes with a mast on the pedestal, boom and tie-rods (e.g. level-luffing and tower cranes).

The largest level-luffing cranes are characterised by great diversity and scope of changes in the measured values, that is: current 100 A, momentum of drive motor 500 Nm, deformation 1000 micro-dilatations, suspension force 1000 kN, level luffing system force 500 kN. The elastic deflections of trails are not large (up to 5-10 mm), but the sinking of trails (rails) exceeds 100 mm. Tall level-luffing cranes with the mass of over 400 t are characterised by lowest critical frequencies of vertical vibration (dangerous for overall stability), whose value is ω=0.3 Hz, [01]. Tower cranes with heights of up to 25 m have the incidental frequencies in the range of ω=0.5-2 Hz, [02]. The matching of the structural eigenfrequency with the excitation eigenfrequency is called resonance. It leads to an increase in the effect of perturbation, and hence the risk of damage, so this eigenfrequency can be named incidental. An incidental frequency must not only have a resonant value, but may also have other values that lead to large displacement amplitudes (for tall cranes

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AUTOMATED VISUAL FAULT INSPECTION OF OPTICAL ELEMENTS USING MACHINE VISION TECHNOLOGIES

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Light-emitting diode (LED) lenses are one kind of common optical elements applied in many modern electronic devices. The LED lens with textured and uneven surface is hard to inspect appearance faults. This research suggests a wavelet packet transform-based partial least squares method to inspect visual faults of optical lenses with textured and uneven surfaces. Three major procedures are conducted to complete the process of fault detection. Firstly, a testing image is transformed to wavelet pack domain and the wavelet characteristics of the sub-band images are extracted. Secondly, the partial least squares scheme is used to multivariate transform with wavelet characteristics to obtain latent images. Thirdly, the latent images are fitted by a regression model to produce a predicted image. After comparing with the original image, we can obtain the residual image where the appearance faults have been separated. Thus, the intricate faults embedded in the complicated appearances of optical lenses could be precisely identified by the suggested method. The effectiveness and accuracy of the developed method are confirmed by expert assessments, as well as by comparative analysis with the known methods in the field of spatial localizations and classification effects of fault inspection.

Key words: Automated fault inspection; Optical elements; Visual fault; Machine vision; Imaging; Inspection; Automation; Faults; Lenses; Texturing; Wavelets

INTRODUCTION

Optical elements are employed to change the condition of light by a diversity of ways comprisingreflecting, focusing, filtering, etc. Lenses areopticalelements with ideal or roughaxial symmetryemitting and refractinglight, which converges or diverges the ray. Optical lenses withcrystal clearappearances areconstructed from optical materials and are bent for converging or diverging emitted beams from an object. Lenses are representatively composed of glass or clearplastic. The intention of freeform optical appearance has been abroadutilized for the glass or plastic optical elements in widespread lighting systems. Optical lensesareextensively applied inmobile phones, computers, vehicles, cameras, light-emitting diodes (LEDs), etc. LED is a semiconductorapparatus that launches visual ray when an electric flowtransits the semiconductor chip. The creation of LED has guided the considerablebenefit and provided the enormousanswerwith regard to both energy reduction and environmental conservationfrom now to later. Representativeutilizations of LED elements comprise indicator lamps, LCDscreen backlighting, automotive signal lighting devices, etc. The effects of LED lensescontainaccurate control over the rays of light, aesthetic appearance, and preventing the waste of light and light contamination. An LED can transmit light to far distance due to the support of lens focus function. Thence, LED lenses are created to enhance the light scattering issues of LEDs and they are abroadused to vehicle lights, flashlights, traffic lights, etc. Appearance differences among the clear lenses, diffused lenses, and textured lenses of LEDs are various designs for providing the lighting energy allocation in the regions of interest and decreasing the unbearable glare influence for the ordinarylightingsystems. Figure 1 shows LED lenses and a LED product with textured and uneven surfaces. Visual faults on the uneven surfaces are difficult to be inspected out for professional censors due to repetitive texture patterns on lens surfaces. The LED products are being manufactured in more compact sizes, which cause more trouble of inspecting products. The most common inspection method for appearance

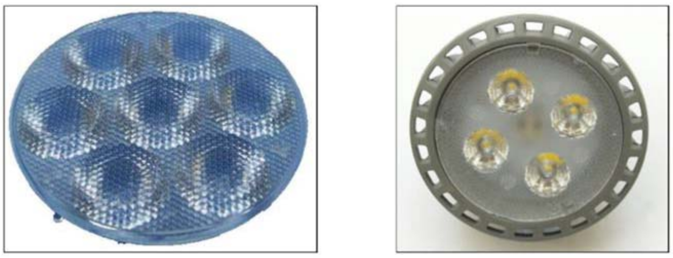

Figure 1: LED lenses and LED product with textured and uneven surfaces.

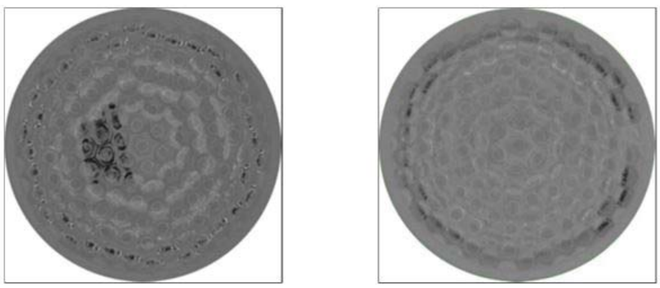

Figure 2: A defective LED lens image and a defect-free image with appearance faults.

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