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New Developments on Coastal and Ocean Engineering

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The Experimental Study on Ocean Wave Energy Conversion Using Wave-Current Turbine

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Abstract

Recently the issues about the potential of the ocean renewable energy in the Indonesian water is wider and wider. There are 3 (three) types of ocean renewable energy resources i.e.: tidal, wave, and ocean thermal energies. Tidal itself consists of hydrokinetic ocean current passes narrow channels and potential energy caused by the different of the tidal height. The technology to convert those energies, of course, will follow the type of energy resources. Indonesian hydrodynamic laboratory BPPT has been developing ocean current converter since 2006 (https://www.youtube.com/user/erw4ndi). The type converter is Darrieus turbine. It only converts the kinetic energy of the ocean current flows in the narrow channel at Larantuka Strait on 2011 and Madura Strait 2013. Since we moved from Larantuka Strait, where the speed of the ocean current is very strong up to 4.2 m/s, to Madura Strait where the maximum current speed under Suramadu Bridge is only 1.3 m/s, we realized that the low current speed at Madura Strait is typical current speed at thousand channels/straits in Indonesia. It lead us to find another ocean energy resource that can enhance the performance of our Darrieus turbine. The wave energy source was selected to improve the turbine. We finally combined Darrieus turbine with Wells turbine to convert both kinetic energy of ocean current and potential energy of wave. We called it wave-current turbine. The presentation will describes the experimental study on ocean wave energy conversion using wave-current turbine. The model of the turbine was tested at Wave Basin and towing tank. The experiment at wave basin showed that the turbine rotated well when the regular wave passed through it. It happened also at towing tank when turbine was towed at certain speed. We also tested the model at Pantai Balekambang, South Malang Regency. The wave energy that come to the beach will be divided into two: potential wave energy and kinetic energy caused by the water flows to and back at the beach. Both of the energies drove the turbine in fluctuated motion. Since the nature of the motion of the water at the beach is not well understood theoretically, we got many difficulties when installing the turbine.

Reconstruction and Prediction of Sea Surface Elevation from (Synthetic) X-Band Radar Images

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Marine radars have been widely used as a wave measurement that can cover a large spatial area. Some researches have shown that wave properties, such as peak period Tp, significant wave height Hs, directional spectrum, surface currents, and water depth, can be derived from radar images. From the sea clutter in the images wind properties could also be retrieved. Since a few years ago, phase resolved waves reconstruction and prediction from radar images have become the main research interest due to a huge demanding from many offshore activities to prevent damage/failure from high waves. The wave reconstruction from radar images is required due to modulations, such as shadowing and tilt, in the radar mechanism. Moreover, the images show the radar backscatter intensity that is not directly related to the wave height. A new approach for the wave reconstruction based on a data assimilation method, called DAES, has been developed. The idea is to perform a dynamic averaging of a low number of successive images and to use this average as update to improve an ongoing evolution of the sea state. This DAES was shown to be capable to predict future waves up to the maximal possible time horizon with correlations between simulated and actual seas between 90% and 95%. The method to retrieve significant wave height and sea surface current will also be presented.

Development of Kapuk Naga Indah in Jakarta Bay
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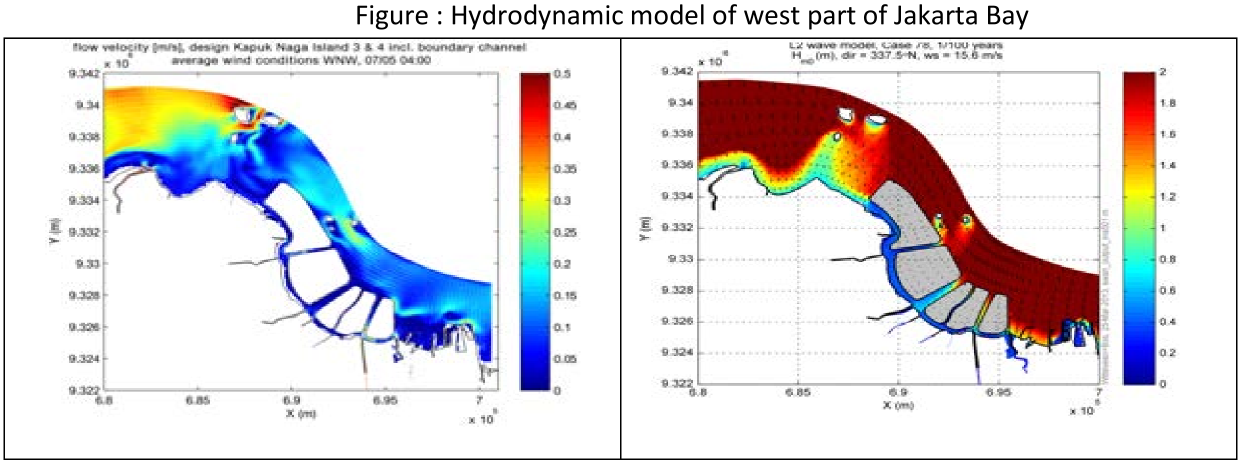
The need for revitalization of North of Jakarta and additional land in the fast growing region of Jabodetabek is large. The Government plans to reclaim land from the sea in front of the coast line of Jakarta. The reclamation area covers the entire Jakarta Bay area. One of the reclamation areas is Kapuk Naga Indah which comprise of 3 islands with a total area of nearly 800 ha.The Islands will be developed as polder system. The subsoil in the area is very soft as it is near river mouth of Cengkareng Drain, it has a large mangrove area. The reclamation works need approx. 50 million m^3 of sand fill material and the dikes around the islands will protected with quarry rock material up to 3 ton in size. To minimize the impact to the surrounding area, hydrodynamic modeling was performed to see the condition before and after reclamation and to proposed mitigation measures. The modeling works include analysis on water level, wave, water circulation, salinity, sediment, and tsunami.Besides the mathematical model, physical model tests were performed to optimize the design of dike. Based on this physical model result, the dimension of rock armour could be optimized.

Figure : Proposed islands in Jakarta Bay

Figure : Physical model test

Figure : Hydrodynamic model of west part of Jakarta Bay



Numerical Approaches as A Tool for Managing Marine and Coastal Resources in Indonesia

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Abstract

In the past, the complexity of coastal dynamics was often solved by means of analytical or physical model approaches. In the last decades, we observed advancement of computer hardware that have led to a fast and more efficient computation process. Moreover, poor availability of field data in both space and time domains has made numerical analyses as the first choice not only for finding optimum engineering solutions but also for the environmental impact assessment processes. For the cases of development in marine and coastal environment, particularly for managing resources and hazard mitigation, several key policies have been publicly released by the government based on the results of numerical simulations. Examples of previous policies based on numerical works such as marine sand mining, Jakarta Bay development projects, coastal erosion in North Java and tsunami mitigation will be presented. The processes and challenges on how numerical simulations were developed and transferred into policies will also briefly discussed. The talks hopefully will provide applied knowledge and motivate the participants on how important the numerical tools for managing the abundance of marine and coastal resources in Indonesia.

Keywords: coastal resources, marine resources, numerical approcah, project cases, policies

DEVELOPMENT OF INDONESIAN LOW PROBABILITY OF INTERCEPT (LPI) RADAR SYSTEM

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Abstract

The development of a low probability of intercept (LPI) radar based on frequency modulated-continuous wave (FM-CW) technology is described. This LPI radar was mounted on a naval ship. Since 2006, the Research Center of Electronics and Telecommunications (PPET-LIPI) has been developing FM-CW radars for various applications. This started with the first generation of Indonesian sea radar (ISRA) using a reflector antenna system, and followed by the second generation, which is the LPI radar, using planar shaped antenna. In the second generation of our radar, the antenna is formed using antenna distribution arrangements, where the side lobe level (SLL) is reduced as compared to the uniform antenna applied on the LPI radar. The LPI radar has two antennas; transmit and receive antennas. In the slotted and co-patched antenna, the achieved SLL value is of 20 dB. This is sufficient to reduce the effect of side lobes from transmit and receive antennas. Signal processing aspects have also been discussed including signal generation, noise removal, beat signal, fast Fourier transform (FFT) process, reflectivity and Doppler spectrum. An example of LPI radar display is also presented.

Keywords: Frequency modulated-continuous wave (FM-CW); low probability of intercept (LPI) radar; antenna; signal processing.

Study Case of Jacket Transportation Particularly in Motion Analysis

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Abstract

Generally in oil and gas construction, offshore structure either floater, jacket, topside or modules will be erected in fabrication yard where the distant between fabrication yard to oil field is far enough. Duration of transportation from yard to oil field can be varied from 7 days until 30 days. Depend on the distance and environmental conditions like sea wave height or wind speed. There are two types of transportation well known in oil and gas industries, they are dry tow and wet tow. Dry tow is very popular for transport jacket, topside and modules. Where the structures will be placed on barge, supported by jacket support, secured with sea-fastening and then using assistantship of tugs boat, barge towed from fabrication yard to the oil field. In the other occasion when the structure to be transported is ship-shaped structure like FPSO, jack up rig, or even spar wet tow methodology is the most popular. Wet tow still using tug assistantship to moving but since structure has their own-buoyancy, structures no need to be placed in barge. Structures just float-on and pulled by tug boats. This abstract limited discussion for dry tow methodology only.For this occasion, writer will bring study case which ever done in 2015, this is jacket transportation from Korea to Yadana field in Myanmar. The structure to be transported is wellhead platform jacket , 4 legs with jacket weight 1687 MT. The jacket will be placed above barge with dimension 330 ft x 120 ft x 20 ft, barge lightship weight is 2312 MT. The actual report consists of barge stability, barge longitudinal strength, barge motion analysis and comparison between motion analysis to Noble Denton recommended practice. The discussion will be limited to barge motion analysis only due this topic is the most relevant for development of Hawassi software. The purpose of motion analysis in this report to help structural engineer check jacket structural integrity during transportation and help them design jacket sea-fastening and jacket support precisely and not under-estimated the effect of environmental parameter to barge motion. Especially due to long distance transportation from Korea to Yadana Myanmar, study of motion analysis need to carried out to ensure the jacket structure designed using correct load. Software using in this analysis is MOSES acronym from Multi-Operational Structural Engineering Simulator. Results expected from analysis are Roll amplitude, Pitch amplitude and Heave acceleration since those three values are using by structural engineer to design sea-fastening and check the structural integrity during transportation.

Simulations of wave penetration into a harbour with an access channel

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Numerical simulations are often used to predict the deformation of waves and their impact on structures in harbours and access channels. An under prediction of these waves could lead to structure failure or ship accidents, and accurate numerical models should be capable to capture the complex physical processes correctly. In this contribution we present numerical simulations of wave penetration into a harbour with complex bathymetry using two different wave models of HAWASSI software (Hamiltonian Wave-Ship-Structure Interaction). The wave models are derived based on a consistent modelling using a variational principle of water waves that produces the dynamic equations in Hamiltonian form. An approximation of the Hamiltonian is required to express the dynamic equations in the surface variables explicitly. Two different methods in approximating the Hamiltonian lead to two different wave models in HAWASSI software: a Variational Boussinesq model (VBM) with finite element numerical implementation and an Analytic Boussinesq (AB) model. The AB model is discretized using a global spatial-spectral numerical method that has been designed to deal with complex boundaries and produces good results very efficiently; the interaction of waves and structures has to be modelled in the Hamiltonian form consistently. Numerical results compared with laboratory experiments for a deep navigation channel towards a harbour will show good agreements.

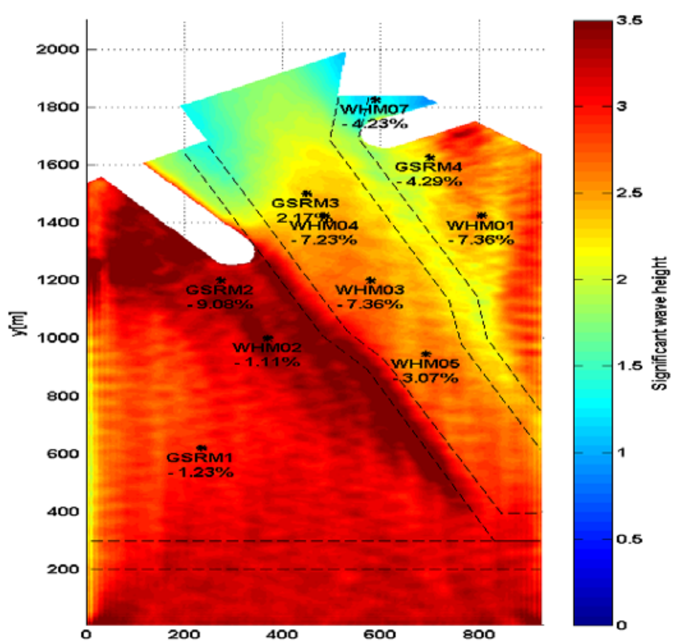

Fig.1 Siginificant wave height of simulation using AB3 for testcase T01. The error of simulation with respect to measurement at buoy positions are indicated