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A Numerical Model Application of Marine Current in the Bangka Strait, Indonesia with a Turbine Arrangement

Parabelem Tinno Dolf Rompas
informatics engineering study program
universitas negeri manado
Tondano, Indonesia
parabelemrompas@unima.ac.id

Heindrich Taunaumang
physics education study program
universitas negeri manado
Tondano, Indonesia
heindrichtaunaumang@unima.ac.id

Ferry Johnny Sangari
electrical education study program
universitas negeri manado
Tondano, Indonesia
ferrysangari@unima.ac.id

Shirly Susanne Lumeno
civil engineering study program
universitas negeri manado
Tondano, Indonesia
shirlylumeno@unima.ac.id

***Abstract*—This study presents the velocity distributions of marine current in the Bangka strait by using a numerical model with a turbine arrays. A RANS method is used to determine the velocities which flowing between the turbines. The velocity distributions in around turbines are simulated with a numerical model. The model calculates only at 0.1 Sv when low and high tides currents. The result is showed that the velocities in around turbines different when low and high tides currents. The result is using to make the turbine profile in the future.**

Keywords*—*marine current, numerical model, turbine array, RANS

I. Introduction

The numerical models and its simulations are used by researchers to find velocity distributions of marine current with a turbine arrays. The numerical simulations of dept-averaged used by [1] to find performance of non-uniform tidal turbine arrays in an initially uniform flow field. Neill et al [2] are studied the numerical simulations of tidal range power plants. The simulation of numerical from [3] are described that wake effects of an upstream turbine can integrated in numerical simulation of an in-stream hydrokinetic turbine.

The power performance of the turbine stream tidal influenced by comparing a control strategy in laboratory and field experiment [4]. A semi-analytic method is used by [5] to optimize tidal farm layouts with the production of mechanical power is maximized. The method is also used by [6] to estimated energy production of a tidal turbine farm by the account of ambient turbulence.

II. Method

The method of this study used the governing equations of RANS that used by [7-12] to find velocity distributions with turbulence model of 3D mixing-length. The boundary conditions are formed by the bottom, the free surface, the wall, and the open seawater.

Fig. 1 shows the map of study in the Bangka strait, Indonesia. In the numerical model, turbine arrays are located between Bangka island and Sulawesi island and one row arrangement.

Fig. 1. The map of study in the Bangka strait

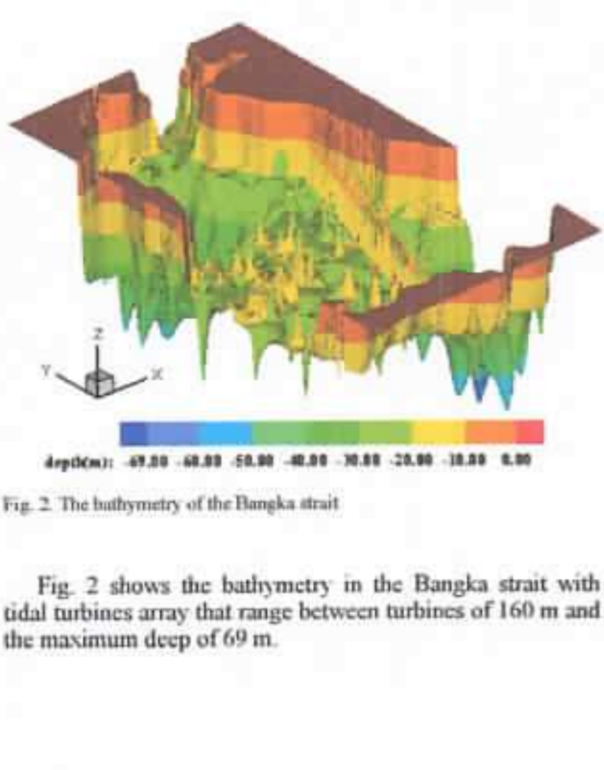

Fig. 2. The bathymetry of the Bangka strait

Fig. 2 shows the bathymetry in the Bangka strait with tidal turbines array that range between turbines of 160 m and the maximum deep of 69 m.

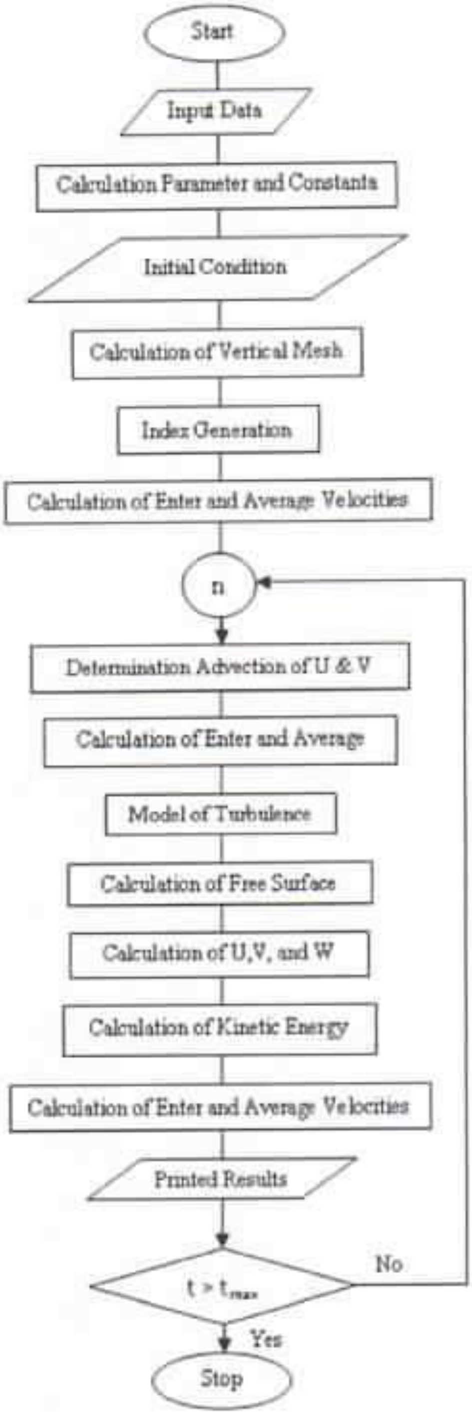

Fig. 3. Flowchart of a numerical model

Fig. 3 shows steps of the numerical model for the calculation of velocity distributions. The input data is the process to read all data that using the all of parameters as explained in [10]. The calculation of Parameter and Constanta needed for calculation of the velocities in direction axes x, y, and z included maximum time to do iteration. The initial condition is the condition of all variables as initial velocities is zero included calculation to *Tecplot* program which is an application for simulation. The vertical mesh is calculated to get the vertical variables as seawater depth. The index is generated to make the layers of vertical axis (depth) and generate index of boundary layers as denote calculating in the meshes. The inside and average velocities is calculated to initial conditions in calculation the velocities.

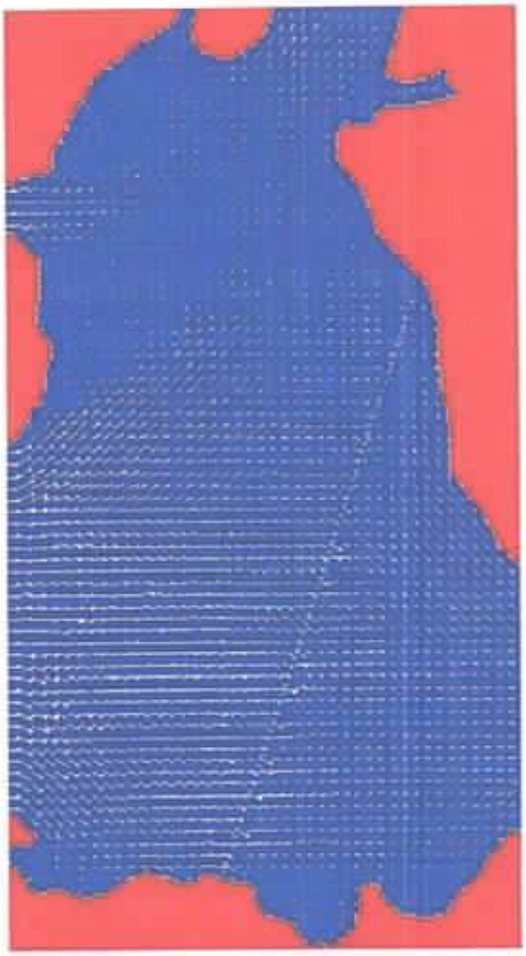

Fig. 4. 2D-simulated of velocity distributions when low tide currents

The "n" symbol shows the quantity of calculation in iteration do-process until maximum iteration. The advection needed to process of determination whether a program can proceed to velocities calculations. The model turbulence used as in [7-12] by using 3D mixing-length. The calculation of free surface is the process of calculation by using a linear five-diagonal system to get the seawater surface elevation. The calculation of components of velocities (U and V) by using a linear three-diagonal included for calculating the convective and viscous term, whereas for calculating velocity vertical W used equation (8) in [7]. The calculation of the kinetic energy used equation in [12]. The calculation results as the velocities and the kinetic energy printed to formulation in the *Tecplot* program for simulation. If iteration is not maximum then back to "n" to do-process, and if iteration is maximum then calculation is stop.

III. Results and Discussion

The velocity distributions are calculated by numerical computational at condition of low and high tide currents. The characteristics of flow in the Bangka strait are conducted by [10-12]. Fig. 4 shows the velocity distributions when low tide currents at 0.1 Sv (1 Sv = 1000000 m^3/s [10]). The results are showed that velocities in around turbines are different when no turbines array as the results that have been conducted by [10, 11]. That's because flow of marine current is blocked by the installation turbine and that applies also when high tide currents (Fig. 5). In the North of turbine arrays, the seawater flows to North before inside the turbines, when living the turbines flows to South.

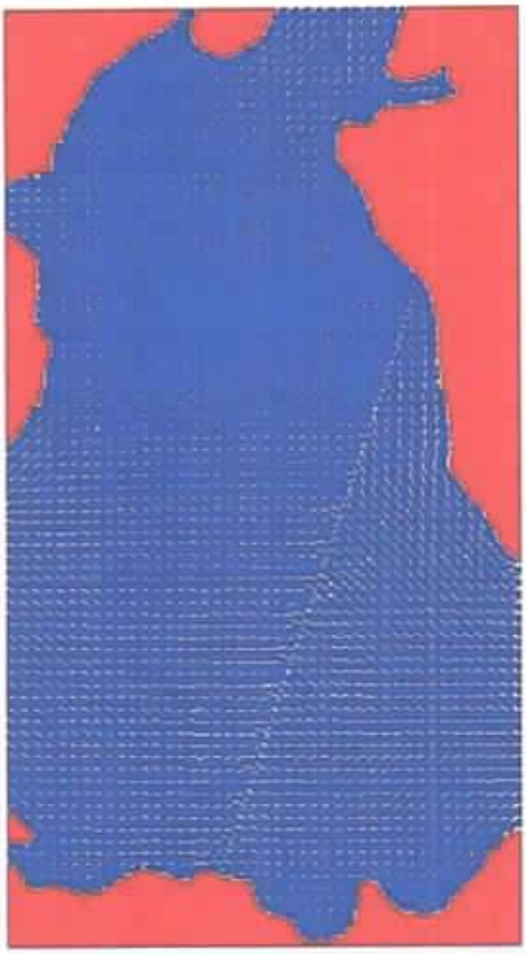

Fig. 5. 2D-simulated of velocity distributions when high tide currents

Fig. 6 and 7 are show the velocities in around of turbines are varied from 0.05-0.80 m/s (when low tide currents) and when high tide currents of 0.05-0.73 m/s (Fig. 8 and Fig. 9). Both when inside and outside the turbines, the velocities are become small and between the turbines become large. The current movement is straight not only before enter the turbines but also after out of the turbines (Fig. 7 is enlarged from Fig. 6 which is marked with red color rectangle), while in Fig. 9 (enlarged from Fig. 8 which is marked with red color rectangle), the current moves before enter the turbines with the direction to Northwest and living the turbines to West. The average velocity before enter the turbines is 0.40 m/s at the low tide current (Fig. 7) and when the high tide current is 0.50 m/s (Fig. 9). When the currents living the turbines, the average velocity at low tide currents is 0.50 m/s and when the high tide current of 0.40 m/s. The results are showed that marine currents that flowing in around of turbines when low tide currents are different when high tide current. The values when low tide currents more than when high tide currents. The result will be used to make the turbine profiles which are using for development of marine current power plant in the future.

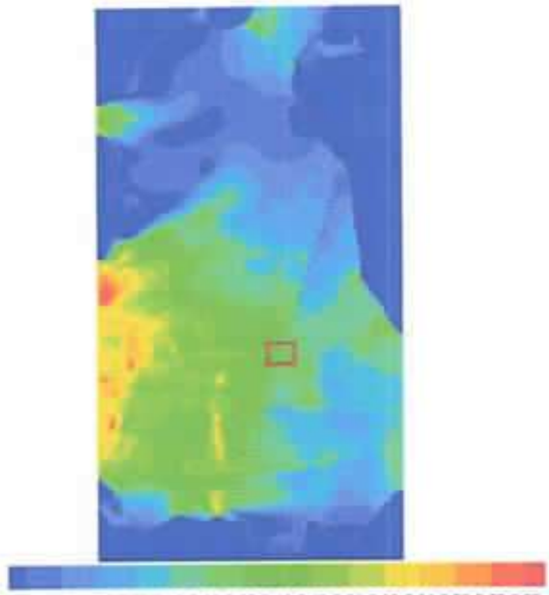

Fig. 6. 2D-simulated of velocity value distributions when low tide currents

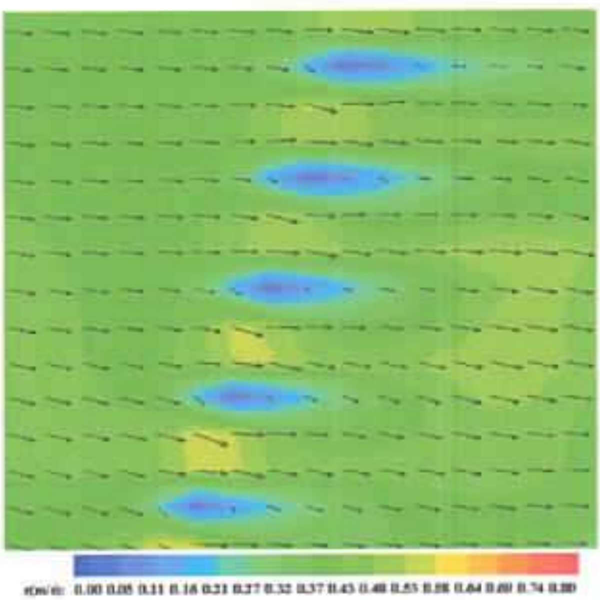

Fig. 7. 2D-simulated of velocity distributions when low tide currents in around the turbines

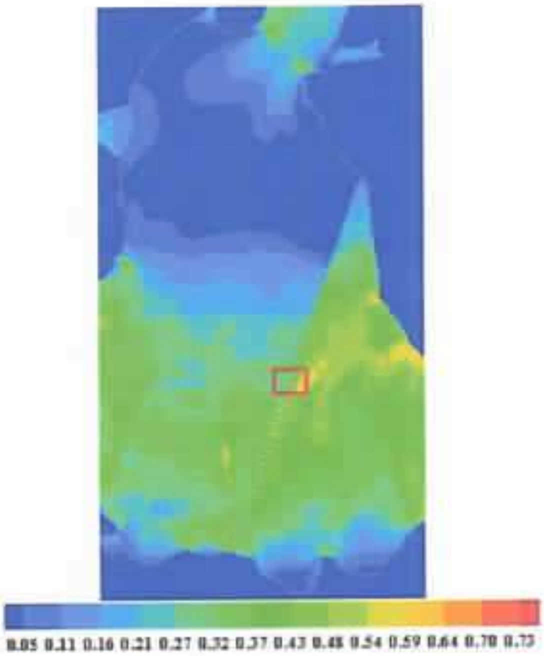

Fig. 8. 2D-simulated of velocity value distributions when high tide currents

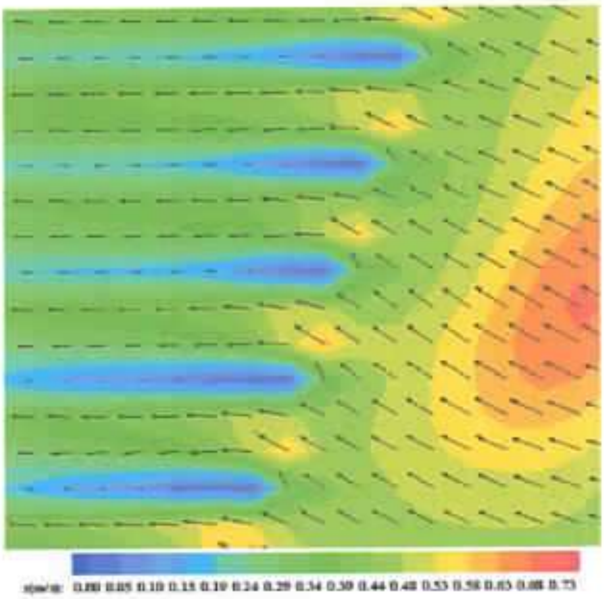

Fig. 9. 2D-simulated of velocity distributions when high tide currents in around the turbines

IV. CONCLUTIONS

A marine current numerical modeling application with a turbine arrangement in the Bangka strait, Indonesia was successfully studied. The velocity distributions when low tide currents are different when high tide currents including the values of velocity distributions. The values when low tide currents more than when high tide currents.

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REFERENCES

[1] P. A. J. Bonar, T. A. A. Adcock, V. Venugopal, and A. G. L. Borthwick, J. Ocean Eng. and Marine Energy, vol. 4, pp. 231–241, August 2018.

[2] S. P. Neill, A. Angeloudis, P. E. Robins, I. Walkington, S. L. Ward, I. Masters, M. J. Lewis, M. Piano, A. Avdis, M. D. Piggott, G. Aggidis, P. Evans, T. A. A. Adcock, A. Zidonis, R. Ahmadian, and R. Falconer, Ren. Energy, vol. 127, pp. 763–778, Mei 2018.

[3] P. Pyakurel, J. H. VanZwieten, C. Sultan, M. Dhanak, and N. I. Xiros, Ren. Energy, vol. 114, pp. 1134–1145, August 2017.

[4] C. Frost, I. Benson, P. Jeffcoate, B. Elsäßer, and T. Whittaker, Energies, vol. 11, p. 1533, June 2018.

[5] O. A. L. Brutto, J. Thiébot, S. S. Guillou, and H. Gualous, App. Energy, vol. 183, pp. 1168–1180, September 2016.

[6] G. Pinon, M. F. Hurst, and E. Lukeba, Int. J. Marine Energy, vol. 19, pp. 70–82, September 2017.

[7] P. T. D. Rompas and J. D. I. Manongko, Telkomnika (Telecommunication Computing Electronics and Control), vol. 16, no. 1, pp. 18-24, February 2018.

[8] P. T. D. Rompas and J. D. I. Manongko, IOP Conf. Series: Mat. Sci. and Eng., vol. 288, p. 012117, 2018.

[9] P. T. D. Rompas and J. D. I. Manongko, IOP Conf. Series: Mat. Sci. and Eng., vol. 128, p. 012003, 2016.

[10] P. T. D. Rompas, H. Taunaumang, and F. J. Sangari, Indonesian Journal of Electrical Engineering and Computer Science, vol. 5, no. 2, pp. 401-409, February 2017.

[11] P. T. D. Rompas, H. Taunaumang, and F. J. Sangari, IOP Conf. Series: Mat. Sci. and Eng., vol. 180, p. 012100, 2017.

[12] P. T. D. Rompas, H. Taunaumang, and F. J. Sangari, IOP Conf. Series: Mat. Sci. and Eng., vol. 306, p. 012102, 2017.

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