Preliminary Numerical Estimates on Tidal Stream Energy Resources of the Coastal Areas of Shandong Peninsula

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ABSTRACT

Tidal stream energy is a kind of important ocean renewable energy. To investigate tidal stream energy resource has to be paid much attention before installing tidal stream power generating instruments. So the candidate article will study and investigate tidal stream energy around Shandong peninsula. The methods and other processes are following.

Numerical simulation method is adopted to get the tidal current of Shandong peninsula surrounding waters for one year. The main 11 tide components’ (Q1, O1, P1, K1, N2, M2, S2, K2, M4, MS4, M6, etc.) harmonic constants and elliptic elements are calculated through using tidal harmonic analysis method. The characteristics of tidal currents around Shandong peninsula are analyzed and the following tidal streams power density is calculated.

The tidal current model is validated by harmonic constants of tide components from over 10 tide stations locating in surrounding areas of the peninsula, which shows the reliability of the tidal current model.

Tidal stream energy of Shandong peninsula surrounding water areas is estimated based on numerical results. The energy flux available of vertical transactions of Chengshantou and Changshan Island are studied in terms of Flux method.

In terms of numerical results, the tidal current velocities given by the model agree with the measured velocities generally. The maximum tidal stream energy density occurs around the eastern end Shandong peninsula.

The details of the analyzing results about tidal stream energy density distribution of Shandong peninsula surrounding areas will be given through further analysis. The results will be meaningful to developers of tidal streams energy around Shandong peninsula areas.

Tidal stream energy generated by horizontal tidal flow is one kind of marine renewable energy. The present work will present some information about tidal stream energy in coastal areas of Shandong peninsula. There are long coastlines, strong tide movement existing in many gulf bay islands water mouth in surrounding water areas of Shandong peninsula. Large probability to have abundant tidal stream energy resources might exist for Shandong peninsula surrounding water areas. For this reason, the research of the tidal stream energy for the above regions is important.

The first step towards this goal is obviously the assessment of the tidal stream resource around Shandong peninsula, in order to select the areas with the greatest potential and to predict the energy production that is able to be achieved. The tidal stream energy potential depends on the tidal currents. Numerical modeling is adopted to assess tidal stream energy and the method involves implementing a numerical model to simulate the water hydrodynamics of Shandong peninsula coastal zones, and validating it based on in situ tidal harmonic constants. After validation, the model can predict the variation of the tidal stream both in space and time with confidence, so that it will constitute a powerful tool for the assessment of the tidal stream energy resource (Blunden et al., 2006). This is the approach adopted in the present work.

This article is structured as follows:

Firstly, the basic aspects of the tidal stream energy estimate tidal flow model, model setting, and results of the tidal stream energy are reviewed.

Secondly, the numerical model with its governing equations and the characteristics of the finite difference grid for its application to the surrounding areas of Shandong peninsula are presented. The following section deals with the tidal harmonic analysis and get tide harmonic constants gathered from over 10 stations for the tide model validation, and the validation itself. The model is then applied to quantify the tidal stream energy resource in the Shandong peninsula.

Finally, two sections for the tidal stream power plant are proposed, and the corresponding tidal stream energy flux outputs are computed.

THEORY DESCRIPTION

Estimate methods of tidal stream energy