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研究タイトル：

潮流発電用ダリウス形水車起動アシスト実験

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キーワード：	潮流発電，ダリウス形水車，起動アシスト，大畠瀬戸，潮流観測
技術相談 提供可能技術：	・潮流の観測および潮流発電 ・ダリウス形水車 ・起動アシスト装置

研究内容：

平成 23 年 3 月 11 日の東日本大震災の影響で起きた原発の事故を受け，日本や世界各国で地球の再生可能エネルギを使った発電がより注目されている．本校のある周防大島町と本州の柳井市大畠の間にある大畠瀬戸の潮流は日本三大潮流の一つに挙げられ全国の中でも極めて速いので大きな電力源として期待されている．この大畠瀬戸での潮流発電を目的にして，我々は，参考文献[1]-[5]を参考にしてダリウス形水車を用いた潮流発電機の開発を行なってきた．ダリウス形水車は，構造がシンプルである，効率が良い，回転軸が縦であるため発電機を簡単に水上に配置できる，また，潮流が転流しても回転方向が変わらないなど，多くの利点を持っている．しかし，起動性に難点があり，水車が起動できる最低流速より，20%以上低い流速下でも発電し回転し続けられることが確認されている．[6] 発電機の運転効率を改善するためには，回転し続けられる最低流速に達するとすぐに起動できるようにするとよい．そこで，採用している翼断面形状 NACA63 3-018 に働く揚力係数，抗力係数の基礎データ[7]をもとにして，潮流による水車のトルクがどのように発生するかを計算し[4]，なぜ起動性が悪いのかを考える．そして，起動に有利な翼の枚数について検討する．また，運転効率の改善のための別の方法として，自己で起動できない程度で回転維持は可能な潮流を受けるときの水車の揺動をとらえ，モータによる外力を加えることによる起動アシストする装置を製作して，起動性向上を試みる．

[1] M. FUJII, and S. WATAYA, Research on the Ocean Tide Generation in Obatake-Seto, The Bulletin of Institute of National Colleges of Technology, Japan, Oshima College of Maritime Technology, No.39, pp. 52-57, 2006. (in Japanese)

[2] T. HIRAMOTO, A Study of Tidal Stream Generation system, Research reports of Coast Guard Research Center, http://www.kaiho.mlit.go.jp/syoukai/soshiki/soumu/seika/h12/05.pdf, pp. 28-34, 2002. (in Japanese)

[3] T. HIRAMOTO, A Study of Tidal Stream Generation, Research reports of Coast Guard Research Center, http://www.kaiho.mlit.go.jp/syoukai/soshiki/soumu/seika/h11/pdf/e06.pdf, pp. 164-169, 2000. (in Japanese)

[4] S. KIHO, and M. SHIONO, Power Generation from Tidal Currents by Darrieus Turbine at Kurushima Straits, Transactions of IEE Japan, Vol. 112-D, No. 6, pp. 530-538, 1992. (in Japanese)

[5] T. TANIGUCHI, et al., Basic Characteristic of Darrieus Water Turbine for Power Generation from Tidal Currents Influence of the Characteristic on a Diameter Size, Proceedings of IEEJ Annual All Japan Technical Meeting, No.7, pp. 179-180, 2003. (in Japanese)

[6] Seiji SHIMIZU, Miku OKIKAWA, Eishi KOGA, Kenji SASA, and Masayuki FUJII, Fundamental Study of Tidal Stream Electricity Generation for Obatake Strait, Proceedings of The International Conference on Electrical Engineering 2012, Kanazawa, Japan, July 8-12, pp. 508- 511, 2012.

[7] Ira H. ABBOTT, Albert E. von DOENHOFF, and Louis S. STIVERS, Jr., National Advisory Committee for Aeronautics, Summary of Airfoil Data, Report No.824, p 170, 1945.

提供可能な設備・機器：

名称・型番（メーカー）	
小型メモリ流速計 INFINITY-EM AEM-USB（JFE アドバンテック株式会社）	小型メモリ水温・深度計 COMPACT-TD ATD-HR（JFE アドバンテック株式会社）
増幅器内蔵トルク変換器 TPS-A（株式会社 共和電業）	

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Starting Revolution Assist of Darrieus Water Turbine for Tidal Stream Electricity Generation

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Keywords	Tidal Stream Generation, Darrieus Water Turbine, Starting Revolution Assist
Technical Support Skills	・ Tidal Stream Observation and Electricity Generation ・ Darrieus Water Turbine ・ Starting Revolution Assist

Research Contents

Japan's experience of the stranded troubles in Fukushima nuclear plants and their inundated damages begun on March 11th, 2011, have made many people in the world need renewable energy sources for electricity as consequences. Obatake strait is well known as one of the strongest tidal current areas in western Japan, that rushes up to around 8 knots, and considered to have high potential as an energy source. It is a narrow channel about one kilometer wide in the Seto Inland Sea, which is a restricted sea area surrounded by the Japanese main island, Shikoku Island, and Kyushu Island. The sea area has very complicated geometries, for examples, plenty of islands, shallow water areas, and fast-flowing straits. So, you can find easily an Obatake strait in the area.

To harness the strong tidal stream power in an Obatake strait, experiments of tidal stream generation with a Darrieus type water turbine have been carried out in an even flow of a circular water tank. Prototypes of a tidal stream electricity generator are fabricated referring former references. Their test results imply that the prototypes will generate stable electricity at an Obatake strait, as shown in a reference listed below, and the Darrieus type vertical axis water turbine in a cylindrical shape, consisting of some straight blades, is simple, efficient, easy to install a generator upward, and keeping a certain direction of rotation in spite of tide change, as good features, but unfortunately difficult to start revolution. Actually as shown in the reference, stopping revolution flow rates of the prototypes are about 20 % lower comparing lowest flow rates to get them rotating (starting).

In order to improve an operating efficiency of the prototypes, it is necessary to get somehow them rotating whenever the tide reaches above the stopping revolution flow rates. First of all, the authors investigate why these types of turbines are so difficult to get starting, using the famous original experimental data of lift coefficient Cl and drag coefficient Cd for straight blades of NACA63 3-018 cross section. During the investigation, the authors also think of a better number of blades for starting. And then, as another possibility to improve the efficiency, the authors try to assist to get the prototypes starting rotation by an additional motor's help driven triggered by a sign, vibration or something, of that the tide reaches above the stopping revolution flow rates.

Shimizu, S., Okikawa, M., Koga, E., Sasa, K., and Fujii, M., 2012, "Fundamental Study of Tidal Stream Electricity Generation for Obatake Strait," Proceedings of The International Conference on Electrical Engineering 2012, July 8-12, 2012, Kanazawa, Ishikawa, Japan, pp. 508- 511.

Available Facilities and Equipment

Autonomously deployable data logger for 2-D electro-magnetic current meter, INFINITY-EM AEM-USB (JFE Advantech Co., Ltd.)	Autonomously deployable data logger for temperature and depth measurements, COMPACT-TD ATD-HR (JFE Advantech Co., Ltd.)
Built-in Amplifier Torque Transducers, TPS-A (KYOWA ELECTRONIC INSTRUMENTS CO., LTD.)	