INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:

Bioinspired Fluid Dynamic Designs and Implementation of Soft Computing Techniques in Savonius Wind Turbine Rotors

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SHORT ABSTRACT

To address the problem of imminent energy crisis, pollution from fossil fuels, and global warming, it is necessary to incorporate the renewable technologies. In that context, the drag-based Savonius wind turbine has tremendous potential to extract wind energy and can be operated as a standalone system at remote areas where the conventional electricity cannot be provided. With such merits in mind, literature review is presented in this thesis besides the research directions and research gaps. It is found that the ongoing research directions are the bioinspired Savonius rotor designs, surrogate modelling, and optimization using soft computing techniques. Concise literature review on the reported bioinspired and nature-inspired blade design of the Savonius rotor is presented. Furthermore, applicability of using soft computing techniques for wind turbines, and especially for the Savonius rotor, is discussed. The potential research gaps are identified and are addressed in this thesis.

In the present thesis, the biomimetic blade design for the Savonius rotor is developed. The novel *priori* flow physics analysis and principal flow conditions are proposed. A marine bio-organism named 'Orange sea-pen (*Ptilosarcus gurneyi*)' is found to be suitable for the novel blade design. An analogy is established between the torque mechanism of the Savonius rotor and feeding mechanism of the sea-pen. A blade shape is derived from the body shape of the Orange sea-pen. A rotor models having sea-pen and conventional semicircular blades are fabricated, and then assessed numerically and experimentally. The results show that the sea-pen bladed rotor performs better than the semicircular bladed rotor in terms of rotor power and starting torque. As an extension of this approach, another novel blade profile inspired from the corrugations found on the dragonfly wings is developed. The numerical findings reveal that the corrugation has a capability of improving the rotor performance.

Further, the surrogate model is created by training Artificial Neural Network (ANN) and Genetic Expression Programming (GEP) consisting rotor's design and operating parameters as input and the performance as output parameter. The Golden Section Method (GSM) is then merged with the trained surrogate models to predict the optimum performance of the rotor having a given design and operating conditions. A parametric study is also conducted to check the capability of the surrogate model. A graphical user interface is then developed as a predictive tool for providing ease to the user.