Cenaero

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INTERNSHIP PROPOSAL

Structural optimization under manufacturing constraints of a braided/pultruded airfoil profile used in Vertical Axis Wind Turbines

Cenaero, located in Gosselies (Belgium), is a private non-profit applied research center providing to companies involved in a technology innovation process numerical simulation methods and tools to invent and design more competitive products.

Cenaero's ambition is to be internationally recognized as a technology leader in modeling and numerical simulation, to be a strategic partner of large global industries as well as a real support to regional companies including innovative SME. Mainly active in Aeronautics, Cenaero wishes to increase the transfer and the application of its technology to surface transport, energy, health and sustainable development. Cenaero operates a top supercomputing infrastructure TIER-1 among the world 500 most powerful systems.

Cenaero provides expertise and engineering services in multidisciplinary simulation, design and optimization in the fields of mechanics (fluid, structure, thermal and acoustics), manufacturing of metallic and composite structures as well as in analysis of in-service behavior of complex systems and life prediction. Cenaero also provides software through its massively parallel multi-physics platform Argo and its design space exploration and optimization platform Minamo.

One of the main axes of development is structural optimization. In the field of composites, we use our in-house optimization platform Minamo to perform techno-economical optimization aware of manufacturing processes. These tools can be used to develop more competitive products adapted to the manufacturing processes. Results obtained from optimization phase ensure direct exploitation based on the constraints imposed by the manufacturing processes. Furthermore, they can be tested and validated in the frame of collaborative projects. The present proposal deals with the structural optimization of an airfoil manufactured with composite materials and that will be installed on vertical axis wind turbines.

Context

In a continuous effort of development of combined numerical and experimental activities, Cenaero is working on a demonstration of fiber braiding and resin injection technologies. These have the potential of automating composite manufacturing processes while maintaining a high level of quality in the manufactured product. Fiber reinforcement architecture in long fiber composite materials are used to confer adequate stiffness and strength to withstand loads.
Developments in different architecture solutions range from NCF (Non Crimp Fabric) composites to 3D composites allowing for multi-axial reinforcement. Interlock braiding stands out as a possible manufacturing technique to manufacture complex reinforcement architectures. These multi-directional reinforcements can give improved behavior in complex loading conditions. They can also be combined with more conventional composite material forms such as woven plies.
These will be used in vertical axis wind turbine blades to satisfy the different mechanical and performance constraints of in-service operations.

Objective

This internship aims at exploiting the numerical tools to perform structural optimization on composite materials. The student will first familiarize himself with examples of composite optimization and setup a workflow adapted to the braiding and pultrusion process of a composite airfoil. The part will be optimized taking into account the different load cases and manufacturing degrees of freedom and constraints. The design space will be analyzed to study the advantages and

drawbacks of technological solutions. Finally, results will be exploited in the frame of a research project to validate a demonstrator that could be installed on a new vertical axis wind turbine.
The internship offered will require the student: (i) to familiarize him/herself with the FE software Abaqus, (ii) to perform structural optimization through simulations and (iii) analyze and present results to bring forward the cost-benefit balance of different solutions obtained. A detailed report of the internship activities will need to be provided at the end of the internship.

Profile

- Master's student in Material Science, Simulation or Engineering
- Knowledge of Finite Elements Analysis techniques, experience with a FEA software is a plus
- Knowledge of composite materials fabrication methods a plus
- Motivated by technical challenges, good communicator, and capability of autonomy
- Comfortable in English

Duration

The length of the internship can range between 4 and 6 months. The internship should take place, at least part-time at Cenaero's offices in Gosselies, Belgium.

Contact

Interested candidates should send a cover letter, quoting reference number of the offer, and a resume to rh@cenaero.be