Airborne Wind Energy as part of the European Project MERIDIONAL: the PoliMi contribution

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In the ever-growing attempt to improve electrification from renewable sources, an important contribution can come from the production of electricity from wind at high altitudes. More and more research groups and companies in recent years are increasingly putting a lot of effort into the design and realisation of Airborne Wind Energy Systems AWESs. The proof that these systems can contribute substantially to the energy mix in the coming years is given by the fact that in 2022, for the first time, the European Commission funded a joint project, MERIDIONAL, in which the AWE case is explicitly mentioned as a target for such research.

The main goal of this MERIDIONAL project, among others, is to better understand and model the complex unsteady inflow conditions which drive loads and performances, and hence the design, of these systems.

In this consortium, Politecnico di Milano (POLIMI) is present with two research groups that have been collaborating, for a few years now, in the development of technologies for the design of AWE. One group has been active for more than ten years in the development of models and control systems for AWES. The second, on the other hand, has been active, for about twenty years, in the more-traditional (i.e. on-shore and off-shore) wind energy system and flight mechanics, and is working on the development of an MDAO approach for AWES. The collaboration between these two mutually complementary groups is essential to better address the various critical aspects of AWES design, mostly pertaining to aerodynamics, aircraft structure, and flight mechanics, and control design aspects, such as the safe switching among different flight regimes and fault tolerant control logics.

Within MERIDIONAL project, the POLIMI activities are focused on 1) carry out field measurements from test campaign in collaboration with the industrial partners. This campaign will include also the development of a flying prototype. 2) Develop technologies to detect inflow conditions (wind velocity and direction, wind shear, etc.) in flight to feed the on-board control system and hence improve the AWES performance. 3) Develop simulation tools to better predict the loads and the performances of AWES in several conditions. 4) and finally to develop Multidisciplinary Design Optimization (MDO) tool to design AWES in different scenario.

The presentation will expand these points together with some preliminary results.