

Invitation to the public defence of the Doctoral thesis of Volkan Salma

Volkan Salma will defend his doctoral thesis on 1 October 2024 entitled:

Safety and Reliability of Commercial Airborne Wind Energy Systems

Abstract:

Airborne wind energy (AWE) is a novel concept aiming to substantially reduce the material demand and environmental impact of wind energy generation. AWE systems can also access steadier and stronger wind at higher altitudes, which is inaccessible to conventional wind turbines. The lower material effort, the increased capacity factor, and the access to so far unused wind resources render AWE a potential cornerstone in a future low-carbon energy economy. The new conversion concept is currently being demonstrated by several start-up companies using different technical implementations at different maturity levels. The unifying challenge for commercialization is the operational robustness of the technology. For a successful market acceptance, the introduced aviation and ground-related safety risks need to be mitigated.

The present work aims to bring AWE closer to commercial success through two main contributions. As a first contribution, well-established practices of reliability engineering are used to measure and then systematically improve the safety and reliability of AWES systems. Experience from other safety-critical domains such as aviation, space, automotive, and medical are used to achieve this objective. A fault tree analysis (FTA) and failure mode and effects analysis (FMEA) are applied to an existing demonstrator system. A common practice in the safety-critical domain is automatically monitoring the system's health and taking action in case of faults. In this regard, a systematic fault detection isolation and recovery (FDIR) model is proposed for AWES. This architecture is generally applicable and flexible and can be applied to different AWE systems.

After reaching the required reliability and safety levels, formalization by the certification authorities is required. As a second contribution, the current regulatory framework is reviewed, the relevant authorities identified and a roadmap for aviation certification is presented. The "Specific Operations Risk Assessment" (SORA) by the Joint Authorities for Rulemaking on Unmanned Systems (JARUS) is a comprehensive and well-structured framework. Therefore, following the SORA is considered the best way forward to get the flying permit for AWES, claiming the "specific" category from the European Union Aviation Safety Agency (EASA) regulation. This permit is applicable for commercial operations in Europe. Other civil aviation authorities may also recognize the EASA's flying permit. In this respect, the SORA is applied to a hypothetical commercial operation scenario, and requirements for the flying permit are discussed.

It gives us great pleasure to invite you all to attend the public thesis defence. The defence will take place in the Senaatszaal at the Aula of the Delft University of Technology, Mekelweg 5, Delft.

Preceding to the defence Volkan will give a brief presentation of the performed research at 12:00, the actual defence ceremony starts at 12:30.

You are cordially invited,

Prof. Dr. Gerard J.W. van Bussel
Promotor

Dr.-Ing. Roland Schmehl
Promotor