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CT has completed the IADGENOL Project on automating AWE System trajectories using Deep Learning.

- **After two years of research, CT has successfully developed a Deep Learning-based control model that addresses the dynamic challenges of autonomous AWE system operations.**
- **In collaboration with Carlos III University of Madrid, CT showcased the results of the latest validation tests in a simulation environment for the AWES control system at the European AWES Congress, AWEC2024, in Madrid, demonstrating precise wind alignment and optimal energy generation trajectories.**

CT has successfully completed the IADGENOL R&D project aimed at researching Deep Learning models for the automatic control and characterization of AWES (Airborne Wind Energy Systems) for wind energy generation. Over the last two years, the CT team has investigated the use of state-of-the-art Deep Learning technologies to enhance control and gain a deeper understanding of wind energy generation systems known as AWES.

"AWES represents an innovative approach to harnessing wind at high atmospheric layers, but they face significant challenges, particularly in operational autonomy. Currently, achieving robust autonomous control is one of the main hurdles; the systems must operate completely autonomously and withstand variable weather conditions over long periods. To enhance the adaptability of traditional control systems, we studied the use of machine learning and reinforcement learning," explains Pablo Egea Hervás, project manager at CT.

The primary objective of the IADGENOL initiative was the creation of a Deep Learning-based control model for the automatic trajectory control of AWE systems, as well as employing these models to understand and characterize the dynamic challenges faced by such systems. This project has been entirely carried out by CT using its own resources and the shared AWES test machine available through a collaborative agreement with Carlos III University of Madrid for the development of AWES technologies. The tasks performed range from preliminary research on the state of the art, data mining and its processing for later use in the development of models, and the development itself of data-based models and the controller, split into four phases.

During last month, the AWES control system developed by CT and Carlos III University of Madrid underwent real-operation validation testing after being successfully trained in a simulation environment using reinforcement learning algorithms and an

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incremental learning methodology. This system, which teaches the aircraft to maintain its position in the air under various conditions and to maximize the tension of the cables, demonstrated its ability to align the kite with the wind and perform figure-eight trajectories, thus optimizing energy generation.

The preliminary results have been presented at the European AWES congress, AWEC2024, in Madrid, highlighting the potential of these technologies to develop robust and adaptive controllers, although further research in this field is acknowledged as necessary.

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About IADGNOL

This project is part of the 2021 call for proposals aimed at research and development projects in artificial intelligence and other digital technologies and their integration into the value chain. It has received funding of €510k granted by the Next Generation funds of the European Union, the Recovery, Transformation, and Resilience Plan, and the Secretary of State for Digitalization and Artificial Intelligence. Project reference 2021/C005/00148256.

About CT

CT is a leading engineering company throughout the complete product lifecycle. For more than 35 years, our mission has been to provide innovative services and technological solutions that help our clients be more effective and competitive. Today, CT´s success is driven by 2.000+ engineers in seven countries providing end-to-end expert support to leading customers in the aeronautical, space, naval, automotive, railway, energy and industrial plant sectors. www.thectengineeringgroup.com