NASA Langley's

Control and Tracking for Tethered Airborne Wind Energy (AWE) Vehicles

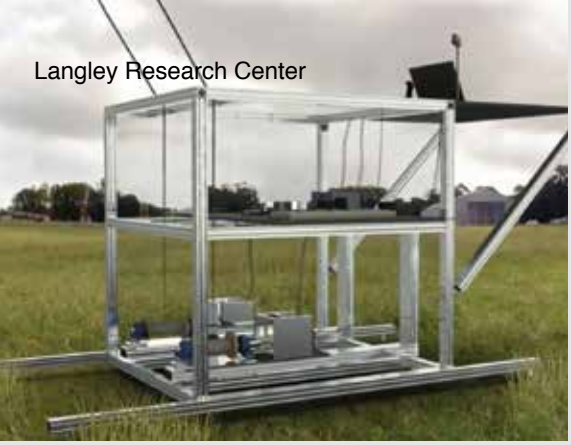
Vision-based system controls a flexible kite in a crosswind trajectory using only ground-based sensors

NASA Langley Research Center has developed hardware and software to track the flight of tethered vehicles, including kite-like, airborne wind energy (AWE) generation systems. The control system consists of a pan-tilt platform and a visible-spectrum digital camera, combined with tracking control software running on a standard PC. The system controls the flight of the vehicle to keep its position on a power-producing trajectory, maximizing velocity (but within limits). This trajectory produces tension, which turns the ground-based generator, producing the energy. The NASA system enables effective operation of groundgen or flygen types of AWE systems. NASA has a working prototype and pre-beta software and is seeking development partners to make it more robust and user-friendly by testing in real-world systems.

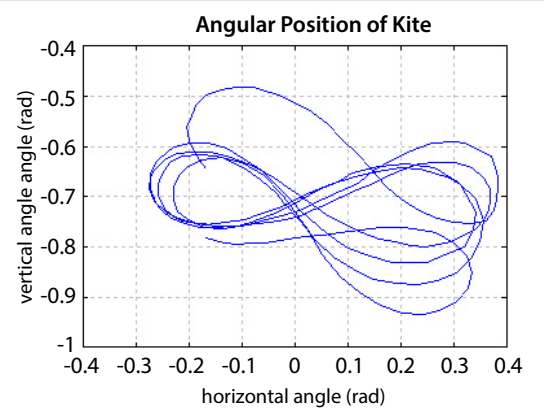
Benefits

- Reliably tracks and controls a flexible kite
- Uses low-cost components
- Uses a low-complexity approach that lowers total system mass by locating the mass of the system on the ground
- Optimizes power generation by keeping the kite in a position to capture crosswinds
- Potentially scales to enable groups of hundreds of kites to fly in flock formation for scalable power

partnership opportunity



Ground station for NASA Langley wind energy prototype



Auto-Pilot Flight Testing – Position from Visual Tracking

Applications

The technology has several applications in the AWE market. Specifically, it can provide tracking and control

- For both groundgen and flygen systems (allowing the designer to move the control system from the kite-end to the ground)
- As either a primary or back-up system
- In both land-based and off-shore applications.

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

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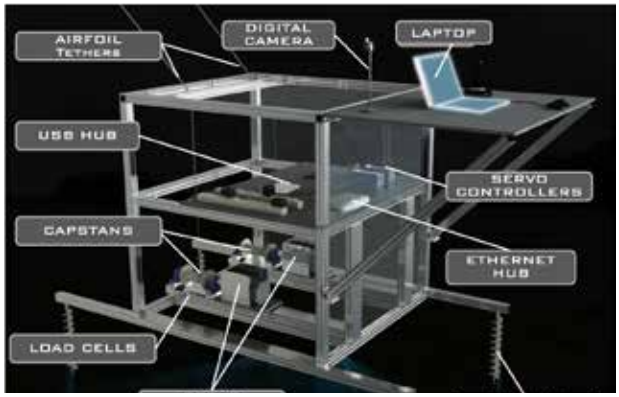
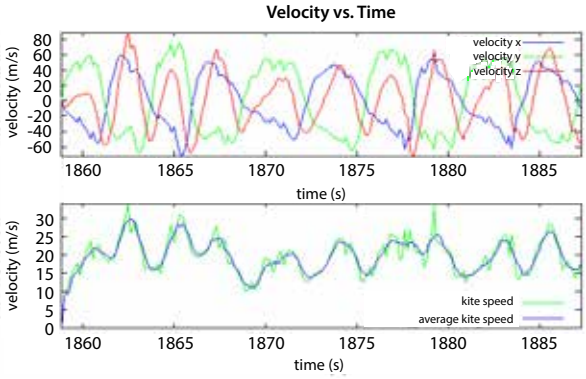
TOA 120
NP-2013-02-454-LaRC

The Technology

The technology of the system controls and tracks the flight of tethered vehicles, including kite-like AWE generation systems. Comprised of a camera, load cells, encoders, an anemometer, and software, the tracking system is based on digital photo analysis. The system tracks where the kite is 30 times every second. The controller makes an adjustment to the tether winch to keep the kite in the controlled trajectory to maximize power at high velocities without exceeding the limits of the hardware. Langley has built and generated power with a 2-kW demonstrator with two tethers (each with its own servo motor) and a pan-tilt unit to extend the field of view of the camera. NASA has flown the system many times and has collected an abundance of flight data. A video of the demo is available on the website http://www.youtube.com/watch?v=DCfw1B2XGQc. The system software is considered to be at the pre-beta stage.





Auto-Pilot Flight Testing – Velocity from Visual Tracking

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