

Aerial cell towers, designed with ANSYS Fluent and Nimbix cloud computing, reduce cost and energy consumption, expanding telecoms into rural markets

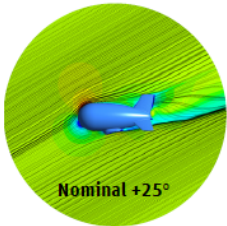
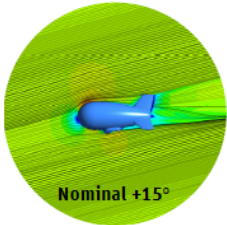
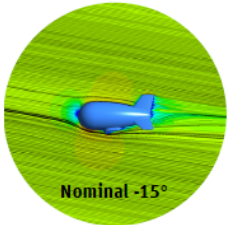
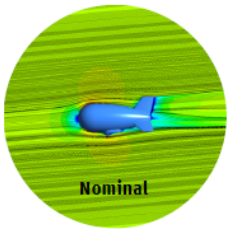


"Using ANSYS' cloud partner, Nimbix, to run Fluent across hundreds of cores has allowed Altaeros to rapidly assess the aerodynamic performance of our prototype designs across a wide range of operating conditions with high fidelity but without prohibitively long run times. The Nimbix platform has proven fast and very easy to use and the technical support from Nimbix has been exceptional."

Jonathan Everitt, PhD
Principal Aerodynamicist
Altaeros

INTRODUCTION

Altaeros has developed a tethered aerial platform called the “SuperTower” as their first commercial product. It delivers high-speed mobile broadband to hard-to-reach rural communities. By innovating a new autonomous flight control system, Altaeros has eliminated the need for manpower to constantly monitor and operate the airborne platforms, drastically lowering the deployment cost. Altaeros has used a model-based design approach to design the aerodynamics and control systems for stable flight at operating altitude, and during autonomous launch and recovery, even in extreme conditions. This has required high-fidelity modeling capability, including the development of an extensive aerodynamic database using ANSYS Fluent and leveraging ANSYS’ cloud partner, NIMBIX.



Altaeros’ airborne platform modeled with wind approaching at a variety of different angles of attack, as modeled in ANSYS Fluent.

CHALLENGES

As with any large-scale, complex system, prototyping is an expensive means for Altaeros to develop the autonomous airborne platform required for the SuperTower – and as a startup company, the risk of a prototype failure is particularly acute. Therefore, creating accurate models that enable early designs to be tested through simulation, before material is ordered or cut, enables Altaeros to minimize that risk.

Aerodynamically, the challenge for Altaeros’ airborne platform comes down to the variability of wind. The system passively weathervanes to point into the wind, but even so, on a short-term basis, the balloon can experience high angles of attack or sideslip that must be accommodated, both in terms of mechanical loads and flight dynamics.

TECHNOLOGY USED

Altaeros uses ANSYS Fluent to perform computational fluid dynamic (CFD) simulations, leveraging cloud computing resources through ANSYS’ partner Nimbix, to model dozens of different operating conditions. By using cloud computing, Altaeros can perform the simulations with manageable turnaround times while maintaining high fidelity.

ENGINEERING SOLUTION

The first use of the CFD results is to develop load cases for the mechanical design of the system and to identify the best location of key sensors such as the wind anemometers. However, Altaeros’ use of simulation extends far beyond this.

Altaeros models the complete system – the rotating ground station, tethers and balloon – in a proprietary flight dynamics simulation tool. The CFD results form a key component as the “aerodynamic database” from which aerodynamic forces and moments are determined. The flight dynamics simulator allows:

- Development and tuning of flight control software.
- Verification of the design for conditions to the limit of the design envelope, which would likely not be experienced in prototype testing.
- Training for operators of prototype systems.

BENEFITS

Altaeros considers that their initial investment in modeling capability and simulation has provided significant payback later in reduced iterations of physical prototypes and in-flight tuning of the control software. Altaeros’ previous flight prototype accumulated autonomous flight experience across a wide range of conditions, validating the design approach. This enabled the design of Altaeros’ first commercial system at a significantly larger scale.

COMPANY DESCRIPTION

Altaeros’ mission is to deliver the next generation of infrastructure to rural and isolated communities. We’ve developed a tethered aerial platform that can be used for a range of applications in energy, telecom, and agriculture. Our first commercial product, the SuperTower, delivers high-speed mobile broadband to hard-to-reach rural communities around the world. Deploying one SuperTower provides coverage equivalent to 15 conventional cell towers at 60 percent lower cost. Altaeros was founded at MIT in 2010 and has raised funding from SoftBank Group Corp., Mitsubishi Heavy Industries, the Suhail Bahwan Group and Ratan N. Tata, and has received technology development grants from, the U.S. Department of Agriculture and the National Science Foundation. The company operates out of Greentown Labs, the largest clean technology incubator in the U.S., located in Somerville, Massachusetts.