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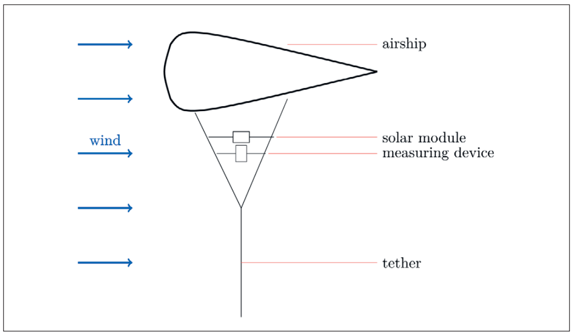
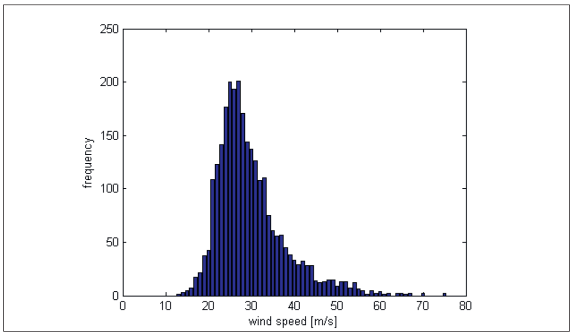
Subject Area	Windenergie

Floating Wind Measurement Device

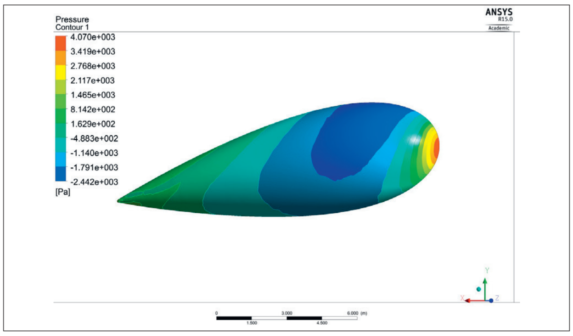
A New Kind of Wind Data Measurement



General idea



Maximal wind speed distribution in Switzerland



Simulation of the pressure on the airship at a wind speed of 80 m/s

Introduction: In order to install a new wind power plant, the local wind distribution must be known as accurately as possible. Currently, the wind data at an altitude of 100 to 200 meters is calculated from measurements on the ground, or determined by the installation of a LIDAR/SODAR (light/sonic detecting and ranging) system, or measured on a mast. LIDAR systems are accurate, but very expensive. A SODAR system, on the contrary, is less precise but cheaper. The subject of this thesis is to investigate whether a flying, and therefore more flexible, wind measurement system is technically and economically feasible. The idea is similar to a stationary balloon which is attached to two tethers. The measurement device as well as the power supply system is placed between them. The measurement device (e.g. anemometer, barometer, thermometer) is mounted on an aluminium profile which is connected to the tethers.

Approach/Technologies: As a first step, the wind regime of Switzerland has to be investigated in order to know which forces will act on the design. To make its shape aerodynamic, its construction is similar to that of an airship. Aerodynamic lift is generated by tilting it slightly. The size of the airship can only be determined by the knowledge of the weight it has to supply. Therefore, all measurement devices, the tethers, the envelope, the carrying structure of the airship and the connection pieces have to be determined. Simulations are carried out to know which forces are acting on the airship.

Result: The airship (or balloon) has the shape of the NACA0030 profile revolved around its central axis. To provide stability to the body, a carrying structure is installed in the interior of the balloon. Between the body and the horizontal axis is an angle of attack of ten degrees to ensure enough lift. The balloon has a length of 15 meters and is filled with hydrogen. Magnitude, direction and temporal distribution of the wind are the most important parameters to be measured. For this reason, two anemometers, two digital compasses, a thermometer, a humidity sensor, and a barometric pressure sensor are installed. The data is stored locally on a data logger. The wind causes pressure on the airship, and this leads to drag and lift forces. At a wind speed of 20 ms^{-1}, the drag force is 3,241N, the lift force 4,146N. Increasing the wind velocity to 80 ms^{-1}, the drag force rises to 51,722N and the lift force to 65,838N. Compared to currently used wind measurement systems, the floating wind measurement device developed is commercially viable.