Wind Turbines for the High Antarctic Plateau

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About the project

The Dome A Wind Turbine is designed to provide renewable energy for future astronomical projects at Dome A, such as the Kunlun Infrared Sky Survey. The turbine will augment, and possibly replace, the power provided by the PLATeau Observatory for Dome A (PLATO-A) which is a self-contained automated platform for conducting year-round experiments. PLATO-A is the result of a scientific collaboration between universities in China and Australia and supports a wide variety of astronomical instruments such as the 0.5m optical telescope AST3 and the Differential Image Motion Monitor KL-DIMM.

The wind turbine is designed to produce an average yearly power of 1kW. The advantages of using wind energy over diesel engines include less maintenance, no need to transport tonnes of fuel each year, cleaner for the environment, and the turbine can start generating power without relying on any stored power – unlike diesel engines, which require considerable energy to start.

Dome A

- Dome A is the highest point on the Antarctic Plateau, at 4km elevation, and the site of China's Kunlun Station.
- The atmosphere above Dome A is very cold, dry, and stable, making it the best earthbound location for many astronomical observations.
- Winter temperatures at Dome A dip lower than -80°C.
- Dome A has an average windspeed at 2 m above the ice of 2.5 m/s, making it the least windy place on earth.

The extreme conditions above, particularly the temperature and wind speed, are the main constraints on the design of a wind turbine for Dome A.

Erection system

Since this turbine is a prototype, it is important that it can be easily lowered and erected for maintenance. A gin pole system is ideal since it can be operated without needing a crane.

Blades

The blades of the wind turbine are specifically designed to maximise power at low wind speed while being optimising for low mass and ease of manufacturing with carbon fibre.

Carbon fibre

Carbon fibre was chosen for both the turbine blades and its 21m tall tower due to its great strength to density ratio as well as its stable performance at low temperature.

Bearings

Due to the extremely low temperatures special attention needs to be spent on choosing suitable bearings. We are considering using solid lubricants such as PTFE for the yaw mechanism bearings, as this is one of very few materials known to work well at low temperatures. These bearings will also be tested in-house at low temperature before deployment.

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Wind turbine model generated using Fusion 360, environment made in Blender

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