Master thesis

Tether Machine for a "Drag Power" Kite

Contact/Applications to:

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Announcement date: June 7, 2022

Motivation

Power generating kites have the potential to generate clean energy at a low cost competitive with coal power plants or cheaper without subsidies (see e.g. [1, 2, 3] and references therein). "Drag power" kites generate power with onboard wind turbines and generators by flying fast crosswind motions, see Fig. 1. Electrical power is transmitted to the ground at a medium voltage level via electric cables in the tether.

Figure 1: Flying Kitekraft demonstrator. (Video available online: https://youtu.be/42jvQpgfm94, accessed: June 2, 2022).

Tasks, Suggested Solution Approach, Expected Results

Fig. 2 shows an early prototype of the tether and its components. In this student work, the

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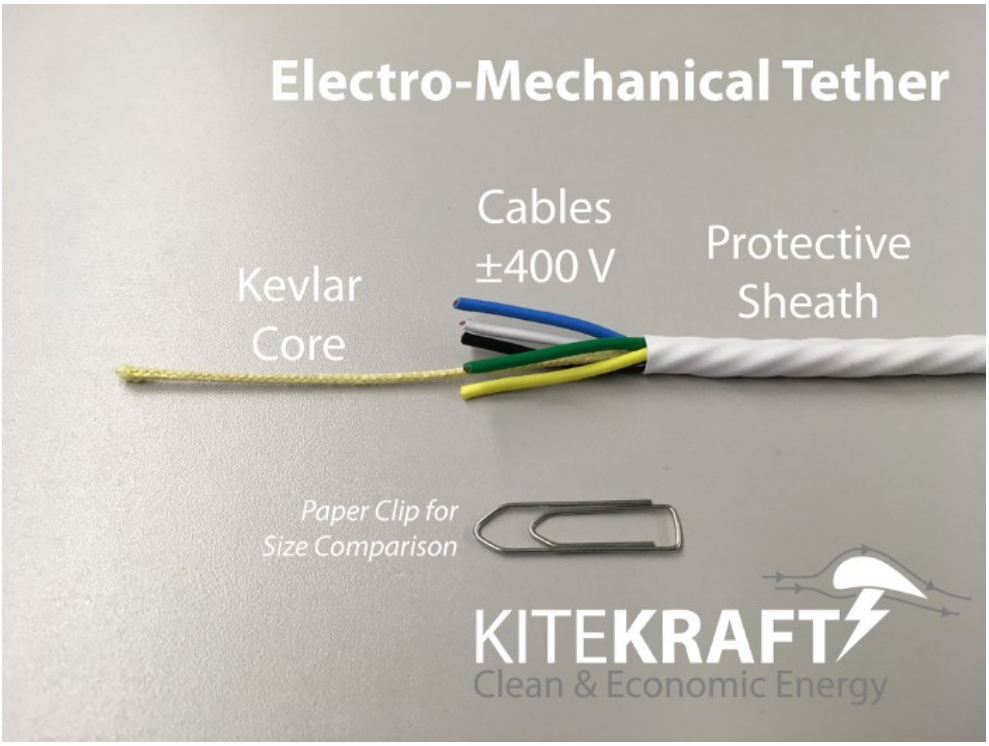

Figure 2: Electro-mechanical tether of the 5kW system with 800V bi-directional electrical power transmission (source: https://medium.com/kitekraft/kitekraft-unveils-5-kw-kite-c7851f7dad8, accessed: Aug 11, 2019).

current tether manufacturing machine, shown as CAD rendering in Fig. 3 shall be re-designed and extended. It consists of 4 stations in which electrical and communication cables are first braided around the Kevlar core, then a protective sheeth is spooled around, before the tether is stored on the final spool. The machine allows for partial automatic/continous manufacturing. In particular, wood parts shall be replaced by metal parts, the manufacturing accuracy of the tether machine components shall be very high for prolonged continuous and precise operation, and for all moving parts proper bearings for low friction shall be used. During tether menufacturing a number of issues have been identified which shall be solved with extions of the machine design (all details are given upon start). The in previous runs identified and used parameters e.g. for the helix of the power and communication cables shall be scientifically substationtiated and critically assessed. Additionally, one or more (simple) accelerated aging test stands shall be designed, build, and used to assess the longevity of the tether (i.e.after manufacturing several short tether pieces with various design/parameter alternatives), after a theoretical investigation of that topic is conducted. At least one new tether for the current kite demonstrator shall be manufactured. This is a hands-on work. The thesis/final report serves as documentation and manual for the newly built tether machine.

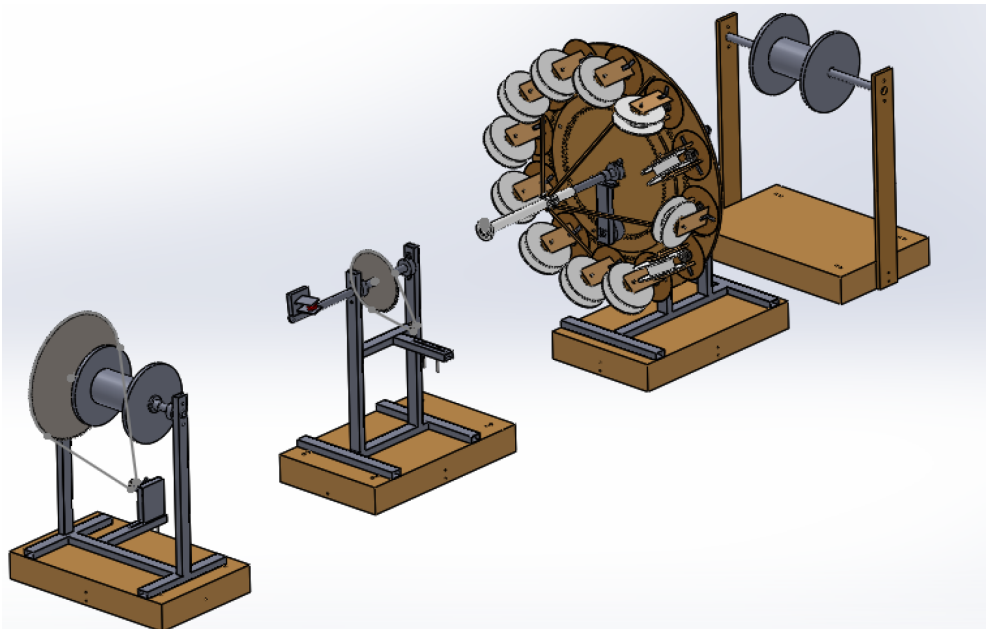

Figure 3: CAD Screenshot of the tether machine [4]

Starting Point

This announcement, the literature list below, and additionally provided internal documents upon start.

Report and Presentation Guidelines

One report (or thesis) and at least one presentation of the results are required. Guidelines and templates can be downloaded from https://github.com/floba/StudentGuidelines.

Your Profile

This student work will be jointly supervised by the Chair of High-Power Converter Systems, TUM School of Engineering and Design and the TUM startup kiteKRAFT. The ideal candidate

- is a student in mechanical engineering, mechatronics, or related fields,
- has expierience in mechanical engineering design including CAD (SolidWorks) and practical protyping,
- has good skills in MATLAB, Office, LaTeX,
- is motivated in the respective field of science and engineering,
- has good English and German language skills.

References

[1] M. Loyd, "Crosswind kite power," Journal of Energy, vol. 4, no. 3, pp. 106–111, 1980.

[2] U. Ahrens, M. Diehl, and R. Schmehl, Eds., Airborne Wind Energy, ser. Green Energy and Technology. Springer Berlin Heidelberg, 2013.

[3] kiteKRAFT: Website, https://www.kitekraft.de, accessed: June 11, 2022.

[4] Tim Augustin: Entwicklung und Bau einer Kabelwicklungsmaschine für einen Zugdrachen. Bachelor Thesis, TU Munich, 2020.