kiteKRAFT founders (from left to right): Max Isensee, Florian Bauer, André Frirdich, Christoph Drexler (13 February 2019)

kiteKRAFT onboard turbines that are also used for propulsion (13 February 2019)

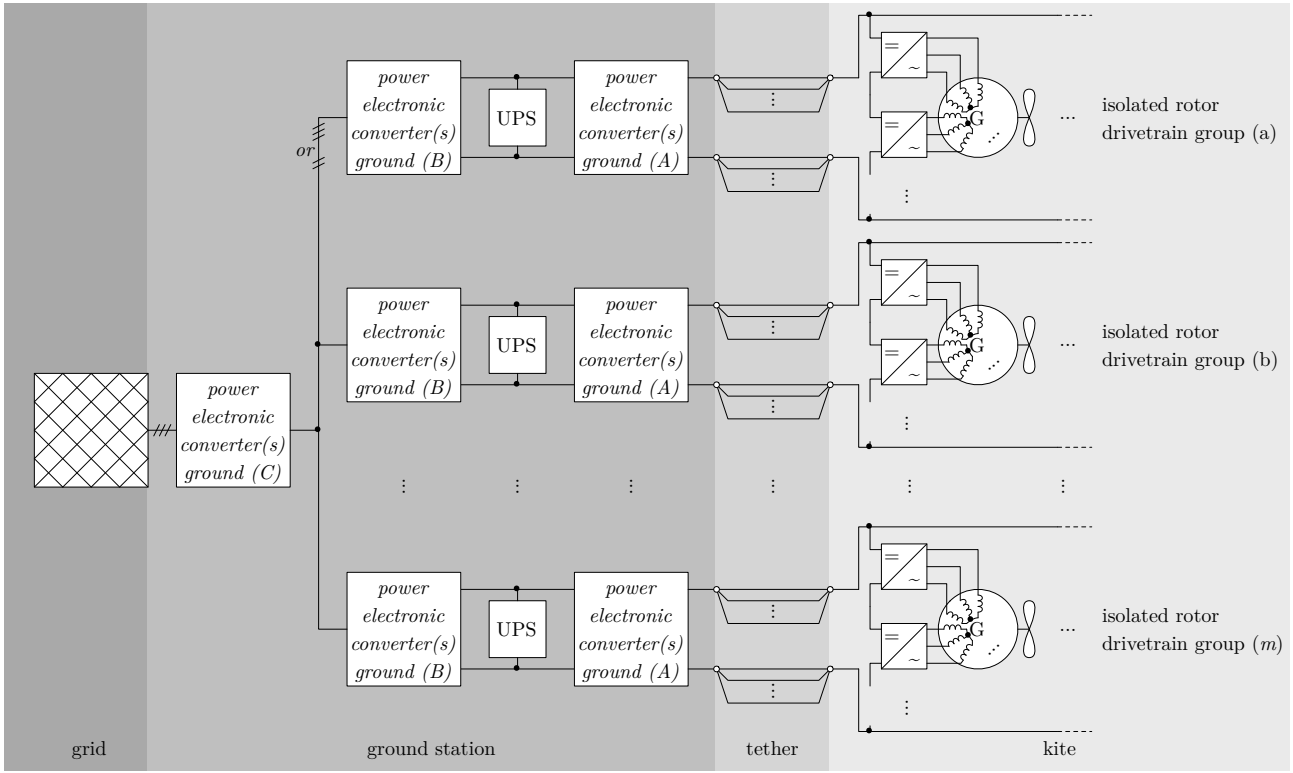

Fig. 1: Proposed power electronic topology for a drag power kite.

Power Electronic Topologies of Drag Power Kites

Florian Bauer, Hannes Börngen, Ralph M. Kennel
Technical University of Munich

Florian Bauer

Technical University of Munich
Department of Electrical and Computer Engineering
Chair of Electrical Drive Systems and Power Electronics

Arcisstraße 21
80333 München
Germany

florian.bauer@tum.de
www.eal.ei.tum.de

Drag power kites belong to the class of crosswind kite power systems, which harvest energy from the wind with onboard turbines [1]. All electricity is generated onboard the kite and transmitted to the ground through electrical cables integrated in the tether. For a high power extraction efficiency, the tether must be thin and light. Optimizations of the tether design reveal the optimal transmission voltage at around 8 kV [2], though with a relatively low sensitivity for off-optimal voltages to around 2 kV [3]. Several kV transmission voltage is a challenging demand for the design of the power electronics, in particular for the airborne part. Besides the goals of low costs, high efficiency, and low weight, the topology and components must be fail-safe and have a low complexity.

In this talk, recently published power electronic topologies are presented and assessed, including those specifically targeted for drag power kites [2,4–7]. To achieve all of the above stated goals, a promising topology is a combination of concepts, visualized in Fig. 1: The different rotor powertrains are electrically isolated from each other as in [5] to achieve a very high fault tolerance with no single point of failure—even a short circuit in the tether has no harm (assuming there are enough isolated rotor-drivetrain groups). Additionally, the electrical machines (motors/generators) have several three-phase windings (multiphase machines), each of which is connected to a voltage-source AC-DC converter, whereas these converters are connected in series on the DC side. This allows to obtain not only the advantages of [4,7] being low-cost and high-efficient, but also having a lower complexity and higher modularity. In particular, no high-power DC-DC converters or transformers are required onboard the kite.

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