

Rotating Reeling

1. Features

Rotating Reeling is a new conversion system working with a rotating kite denoted "Parotor" and comprising a parachute as hub and soft, for scalability towards km range, or semi-rigid wings or blades. It is a sort of synthesis of methods said yoyo and carousel, but where kite span is roughly the same as lines lengths. So Rotating Reeling and Parotor (RRP) allow a full maximization of land and space used [1,2,], avoiding difficult management of a farm of kite systems where mobile and relatively long tethers prevent such a maximization. RPM of both conversion system and Parotor are very low, under 1 in scale. Linear speed of both hub and ring are roughly wind speed. A cyclical piloting of wings allows to remove lifter kite. Launching and recovery are by using mobile stations as anchors. Next step: automated 30 m span wing, 100 kW range. Full scale is 1 km span, 1 km altitude.



Proof of concept flying. Elements are the same as on the figure.

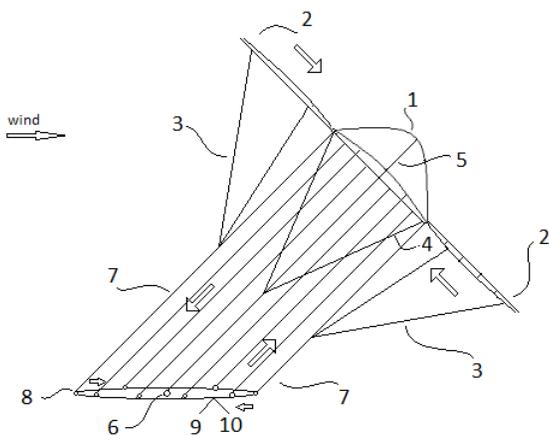


Figure 1

There is one rotating kite (1 and 2) in the air and one ring (9) of mobile stations (8) on a circular track (10) on the ground. The two systems are connected by peripheral lines (7) from the opening of parachute (1) towards mobile stations (8). The angle of attack of the rotating kite (1 and 2) is assured by its hangers (4) tied in the central rope (5) joining the central station (6). Since the kite is tilted while the conversion system is horizontal there are cyclical variations of length of peripheral lines (7). So generators can be settled within mobile stations (8), reeling-out being for the half of the ring turning upwind. Alternately a generator can be settled between the ring (9) and the circular track (10), the conversion being roughly for the half of the ring turning downwind, reeling being used to smooth the cyclical variations of lines lengths.

2. Land and space used [2]

Figure 2a

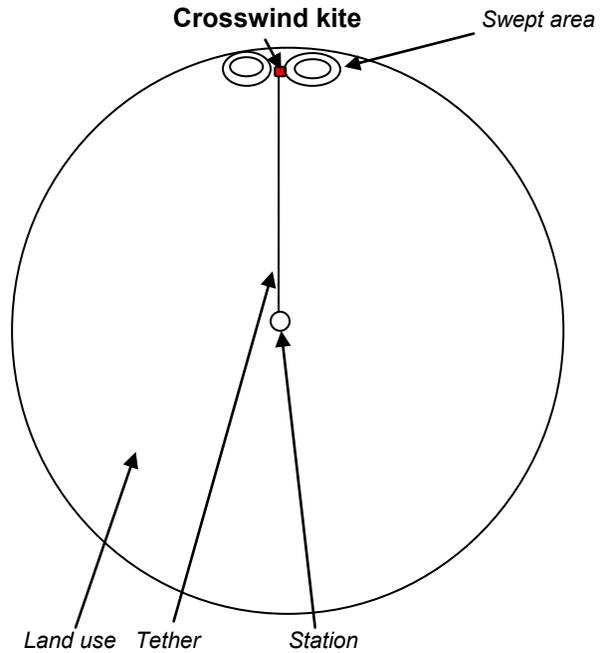
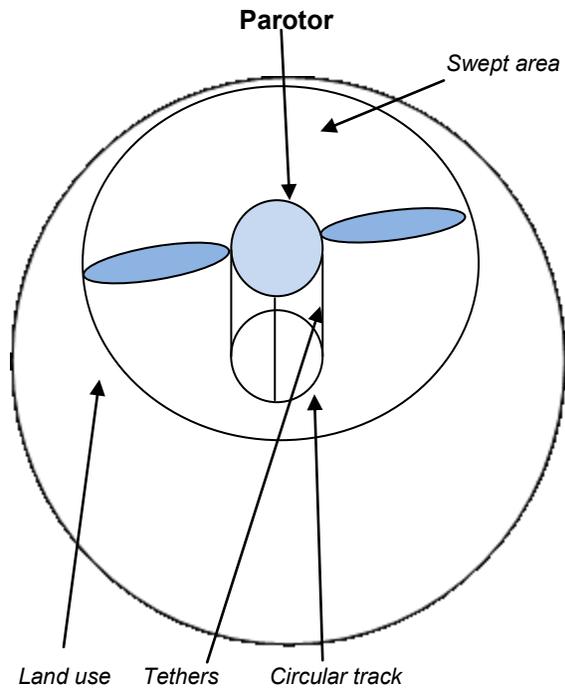


Figure 2b



Figures 2a and 2b represent land area by view from the top. Both swept areas are considered as tilted (45°) areas planned on a horizontal plan.

Current AWES prototypes (Fig. 1a) are almost crosswind kites working according to methods said yoyo (ground generator) or flygen (generator aloft), and are linked into a single anchor as station. So expected configuration is a relatively long tether as radius of circle of land use; and a relatively small wing.

Concerning Parotor (Fig.1b) swept area can be optimized by rotating motion, stationary conversion system, multi anchoring by mobile stations (8) on ring (9). So a highly scalable soft kite [3] can be implemented.

References with brief comments

- [1] Joseph Beaujean : *Harvesting High Wind Energy SkySails for Wind Turbines* <http://www.energykitesystems.net/Beaujean/SkySailsforWindTurbines2012.pdf> Comment: a single rotating AWES instead of a kite farm.
- [2] Pierre Benhaïem : *Land and Space Used*, Airborne Wind Energy Conference 2013, Book of abstracts p.59 http://www.awec2013.de/pdfs/AWEC_2013_BoA.pdf Comment: towards a maximization of space.
- [3] Jeroen Breukels, W.J. Ockels: *A Multi-Body System Approach to the Simulation of Flexible Membrane Airfoils*, Aerotecnica Missili & Spazio, The Journal of Aerospace Science, Technology and Systems Delft University of Technology Institute for ASSET <http://www.kitepower.eu/images/stories/publications/breukels10.pdf> Comment: studying deformations also to scale up.