Development of Novel Wind Turbines Hybridized between Permanent Magnet Disks and Additional Motor/Generator for Extending Operating Range and Enhancing Conversion Efficiency

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Novel hybrid wind turbines are proposed in the present project. The turbines utilize coupling permanent magnet disks and additional motor/generator to widen the range of operable wind speed and enhance the turbine efficiency. Four versions of the turbines have been developed. Each version has different turbine sizes and configurations but is operated under the same general concept. In a low wind speed situation, normal turbines usually stop because the converted wind force cannot overcome the friction. They will return to operation when the wind speed is above their cut-in speed. On the contrary, our hybrid wind turbines are kept rotated by the motor in low wind to avoid the static friction. We have experimentally tested our turbine in a wind tunnel. At low wind speed, the hybrid wind turbines can still generate power while the normal turbine stops. The results indicate that additional components can improve the overall turbine efficiency. In a strong wind situation above the cut-out wind speed, normal turbines must be stopped to avoid permanent damage and possible unsafe operation. For hybrid wind turbine, the second generator is coupled via the permanent magnet disks to increase the mechanical load, hence, reduce the turbine speed and increase the power conversion. It has been demonstrated in this work that our novel coupling system can be applied to both horizontal and vertical turbine configurations.

Awards Won:
Third Award of $1,000