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Title

Investigating the power and energy flows for a Kinetic Energy Recovery from a landing aircraft

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Abstract

As part of the efforts towards the abatement of climate change, the European Union has set targets for the emissions in the aviation sector. In particular, all aircraft movements on the ground are set to be emission-free by 2050 [1]. Airport carbon footprint analysis and accreditation demonstrate that aircraft ground movement accounts between 5-20% of all airport emissions [2]. Conventionally, engine thrust is used during taxiing to provide forward propulsion. A typical 10-minute taxiing process for a narrow body aircraft consumes approximately 100 kg of fuel with a considerable amount of carbon and NOx pollutants released at ground level. The reduction of emissions on the ground is important as it has strong links with respiratory illnesses, amongst others. As airports and cities continue to grow, these get in closer proximity to each other, heightening the effects of the problem. Research has been directed towards extending the technological barriers for green aircraft taxiing. Whilst motor technology was viable [3], the auxiliary power unit had to be redesigned such that the generator would be able to supply sufficient electrical power to the in-wheel motors. This would result in a costly retrofit and an excessive addition in weight, thus offsetting any benefits on the ground to the in-flight portion. This paper addresses this shortcoming and proposes that a portion of the kinetic energy of the aircraft is recovered during the landing rollout. The energy recovered is stored temporarily in an onboard energy storage system (ESS) and then utilised for taxiing purposes.

This paper investigates the power and energy flows between the motors on the landing gear and the onboard ESS. The paper provides a model of the kinetic energy recovery system for a landing aircraft which simulates and compares the power and energy flows for narrow body and regional airliners under various operational scenarios. Two traction motors are considered in the main landing gear, connected via a bidirectional power electronic interface to the ESS housed on board the aircraft. The ESS is charged during the landing rollout and then discharged for taxi purposes. Combinations of the conventional deceleration techniques in addition to the introduced electrical motors are examined under typical landing rollout and taxi conditions. The necessary aircraft engine cooldown and warmup periods are included in the analysis. Simulated results show that the captured energy and hence the taxiing capability depends on the configuration used for landing and the rating of the traction motors. It was observed that the short rollout time places a stringent demand on the power rating and dynamics requirement of the used technology.

References

[1] European Comission, "Flightpath 2050 Europe's Vision for Aviation ," European Comission, Belgium, High Level Group on Aviation Research 2011.

[2] ACI Europe. (2021) Airport Carbon Accreditation (Accessed on 15th May, 2021). [Online]. https://www.airportcarbonaccreditation.org

[3] Lukic, M., et al., "Review, Challenges, and Future Developments of Electric Taxiing Systems,". IEEE Trans on Transp. Electr.,(5), 4, (2019).