Design of aircraft integrated ground control laws

Soutenance de thèse – Edouard SADIEN
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Résumé

To achieve a high performance level during ground operations, the lateral dynamics of an aircraft must be controlled using all available actuators (rudder, nose-wheel steering system, engines and brakes) and under various constraints, which gives rise to a challenging allocation problem. To address this issue, a simple yet accurate design-oriented on-ground aircraft model is first developed. It takes into account the effects of aerodynamics, thrust and tire-ground interactions, both laterally and longitudinally, and for several runway states. It is validated on a high-fidelity Airbus simulator and a complete set of numerical values representative of a commercial aircraft is given, as well as design objectives, so as to provide the control community with a challenging benchmark. After an extensive literature review and an evaluation of the pros and cons of many existing control allocation techniques, a novel and easily implementable algorithm is then developed, which meets actuator and implementation constraints. It automatically manages the trade-off between two antagonistic objectives, namely minimizing the control effort and attaining the maximum virtual control. Its validation on both the design-oriented model and the high-fidelity simulator shows promising results, and flight tests on a real aircraft are scheduled in the short term.

Mots clés

on-ground aircraft modeling, ground control architecture, control allocation, Monte Carlo-based validation.