Integrated schedule planning for a new generation of aircrafts

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Abstract

Optimizing transportation operations is one of the most important paths towards sustainable transportation. To achieve this goal in the context of multimodal transport, there is a clear need for flexibility in capacity. This flexibility is adequately provided by a new concept developed at EPFL, named Clip-Air, for air transport. Clip-Air is a modular innovative aircraft with detachable load units which enable to adjust at best capacity according to demand. The decoupling of the load (capsules) and carrying units (wings) allows for simplified fleet management and maintenance operations for airlines. The objective of this research is to quantify the potential advantages of Clip-Air by developing appropriate models and algorithms. An integrated schedule planning model is built for both standard planes and Clip-Air fleet where the decisions of schedule design, fleeting and pricing are made simultaneously. In order to better represent the demand, an itinerary choice model is developed with logit formulation, which is also used for the spill and recapture effects. Preliminary analysis shows that enhanced flexibility of Clip-Air allows to transport around 15% more passengers with the same overall fleet capacity. The used integrated schedule planning model is a mixed integer nonlinear problem and to deal with the high complexity, we are developing a heuristic method based on Lagrangian relaxation and sub-gradient optimization.

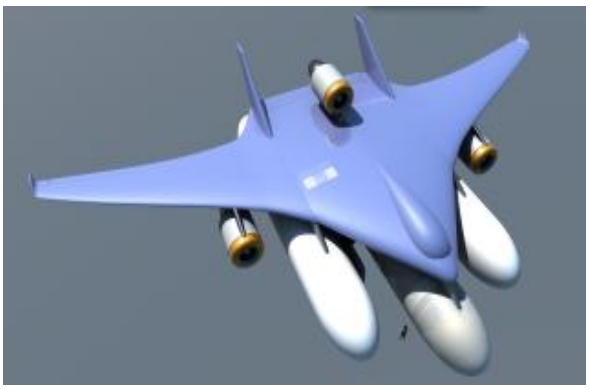

Figure 1: A demonstration for Clip-Air wings and capsules

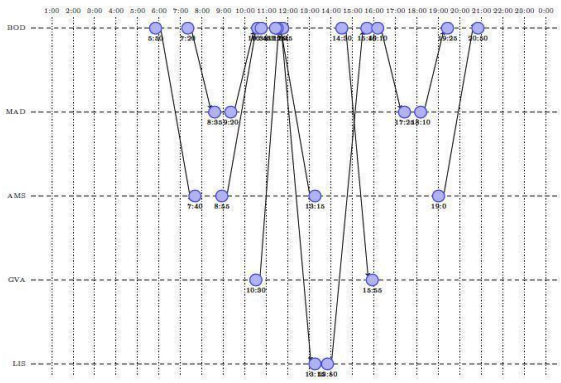

Figure 2: An example for the time-space network representation of the schedule