

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Future Space Transportation Systems Technologies (5)

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## ADVANCED AVIATION TECHNOLOGY FOR REUSABLE LAUNCH VEHICLE IMPROVEMENT

**Abstract**

All launch vehicles (LV) operate only in the atmosphere, so many aviation technologies may find effective application for such aircraft.

The interaction of aviation and space technologies becomes stronger for a partially and fully reusable LV (RLV). In these cases, LV' stages should be rated on flight conditions at ascent and reentry phases.

In this regard, the paper considers a chain of interrelated problems, which are perhaps new for the space technology, but have practical examples of effective solutions in the aviation industry. They are as follows:

- creating RLV image
- development of a reuse concept
- synthesis of transformable configurations of recoverable winged boosters(RWB), which enable to adapt for widely varying flight conditions at ascent, reentry and landing
- robotization of the RLV complex
- optimization of an aerodynamic layout of RWB
- through optimization of branching atmospheric RLV trajectories
- optimal distribution of RWB landing sites
- safety of an automatic RWB landing, including a power-off landing
- comprehensive calculation of the cost of construction and operation of RLV complex, taking into account the maintenance of airfield equipment.

Solutions of these problems are demonstrated on examples of the RLV with a first-stage's RWB and fully reusable LV. RWB concept features for Russian and European (Kourou) launch sites are discussed.

There are demonstrated original RWB layout decisions for first and second RLV stages, which are able to transform profoundly depending on the phase of flight to ensure requirements of flight safety and efficiency of both the related payload mass and cost. The integrated account of pointed technological capabilities enables to offer RLV layouts with advantages over expendable ones in terms of not only the environment impact, but also the cost even at a low re-use frequency.