Why identification fails in modeling of flying objects for simulators and why this cannot be overcame? New approach to modeling based on AI concepts

Franciszek Dul

Institute of Aeronautics and Applied Mechanics, Faculty of Power and Aeronautical Engineering,
Warsaw University of Technology, Warsaw, Poland
franciszek.dul@pw.edu.pl

Abstract:

The paper address the question of failing of the identification-based modeling of flying objects for simulators. Based on many years of experience gained in the worldwide aviation and space industry, it will be shown that classical Newtonian modeling with identification based on flight test data is insufficient to build models of aircraft whose flight properties would be accepted by pilots. It will be also shown that modeling based on deep learning of neural structures, which works very well in general AI, also does not resolve the problem of inadequate modeling. Moreover, it will be shown that deep learning based modeling does not match the reality of modeling for simulators, because, the amount of data from flight tests is usually far from sufficient, cost of gathering them is very high, and their quality is often very poor. In addition, the duration of the projects does not allow for the use of general methods of off-line deep network learning in real conditions.

The general thesis will be presented, that the modeling of flight properties based on data from flight tests is poorly-conditioned and thus is of little usefulness. To overcome this fundamental problem, the reversed approach, based on pilots opinions is then proposed. A new modeling methodology will be presented, that combines classical and learning-based modeling, combining basic physical model and supplementary structures to teach the model flight properties based on pilots opinions, both precise, quantitative, and subjective, qualitative and even emotional. It will be also shown, that such modeling is in line with the postulates of agile programming: it is adapted to real conditions, taking into account both substantive requirements and non-substantive (organizational) factors that are of key importance for the success of the project.

The usefulness of the new methodology will be illustrated on the example of modeling an aerobatic turboprop aircraft.