Probabilistic Safety Verification of Future Air Traffic Management

Henk A.P. Blom, PhD
National Aerospace Laboratory NLR
Amsterdam, The Netherlands
blom@nlr.nl

Abstract
Despite advances in formal and probabilistic verification approaches, fault and event trees are still the dominant techniques used for safety risk analysis in aviation. However, the combination of concurrent, dynamic, and random effects that appear in air traffic cannot properly be captured by these classical techniques. In this lecture, it will be explained how safety risk modeling and analysis can be formulated as a problem of estimating the rare event probability of a large scale stochastic hybrid system. Subsequently it is explained how rare event estimation theory for diffusions can be extended to a large scale stochastic hybrid system (SHS), in which a large number of rare discrete modes may contribute significantly to the rare event estimation.
Essentially, the approach taken is to develop a compositional model of the air traffic operation considered in the form of a large scale SHS; then to introduce a suitable aggregation of the discrete modes of this large scale SHS; and then to develop importance sampling and Rao-Blackwellization relative to these aggregations. The practical use of this approach will be demonstrated for the estimation of the mid-air collision probability for an advanced air traffic application.

Further reading: