Air Traffic Simulator

The traffic simulator is designed to support the development and validation of Pilot Assistant Systems dealing with airborne separation assurance systems and air traffic management tools. It is as well suitable as a “proof of concept simulation” for new ATM-concepts or operations. The Traffic Simulator supports two kinds of traffic scenarios:

- Simulation of the surrounding traffic of one aircraft for airborne separation assurance tools
- Simulation of up to 1000 aircraft departing and arriving traffic for air traffic management tools

The main functions of the traffic simulator are:

- Simulation of traffic scenarios with a variable number of aircraft, aircraft types and flight plans.
- Simulation of an air to air data link for airborne separation assurance scenarios and of an air to ground data link for air traffic management scenarios.
- Provision of a graphical user interface for
  - Generation and modification of the traffic scenario
  - Easy generation of conflict points between different aircraft
  - Modification of a scenario via events during a simulation run

A traffic scenario is composed of a variable number of aircraft. For each aircraft one must define:

- The aircraft type, which can be one of the defined aircraft types in Eurocontrol Base of Aircraft DA ta (BADA)
- the flight plan,
- Takeoff time or aircraft state vector for the starting position.
The traffic simulator generates a 4D-trajectory for each aircraft participating in the scenario and moves the aircraft along the trajectory in real time or fast time. The input data for the generator are a flight plan, the aircraft performance data, aircraft state vector at starting position and meteorological data. The starting position may be on ground, at the departure airport or airborne. The trajectory generator takes account of altitude constraints, speed constraints and time constraints which may be specified in the flight plan.

**Surrounding Traffic of a Particular Aircraft**

For this purpose the air traffic simulator simulates the surrounding traffic of one particular aircraft and generates the data of an air to air data link. This particular aircraft might be a real one using the simulated date during flight tests, or an aircraft simulator using the data during simulation runs or the traffic simulator is simulating the particular aircraft as well. The traffic simulator generates the data of an air to air data link, however without considering the physical data link behaviour. The traffic simulator contains a conflict prediction and a conflict resolution module as well. The conflict prediction module predicts the intersection of the trajectories of any of the surrounding aircraft with the trajectory of the particular aircraft. A collision, which should be detected and avoided by the airborne separation assurance system onboard the particular aircraft of interest, can be forced by selecting an intersection area on the graphical interface. So potential collisions can easily be introduced into the traffic scenario at any time during a simulation run.

A test aircraft can carry the traffic simulator with it during flight test to simulate surrounding air traffic.
Departure and Arrival Traffic of an Airport

Traffic simulator connected to four different aircraft simulators at the same time: Generic Experimental Cockpit (GECO) Brunswick, VFW-614 simulator Brunswick, Airbus 330/340
In this kind of scenario the air traffic simulator simulates the departure and arrival traffic of a specific airport and generates the data of an air to ground data link, however without considering the physical data link behaviour.

When an aircraft enters the TMA, the traffic simulator negotiates its trajectory with an air traffic management tool until the aircraft gets a clearance for its down linked trajectory. Negotiation means, the aircraft sends its predicted trajectory down to the ground station and regenerates its 4D-trajectory, considering the received uplink data, which may contain route, altitude, time or speed constraints.

The traffic scenario can be extended by introducing cockpit simulators during a simulation run and even real aircraft during a flight test.