

# Modeling and Analyzing Air Traffic Control Systems using Ptolemy

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## MOTIVATION

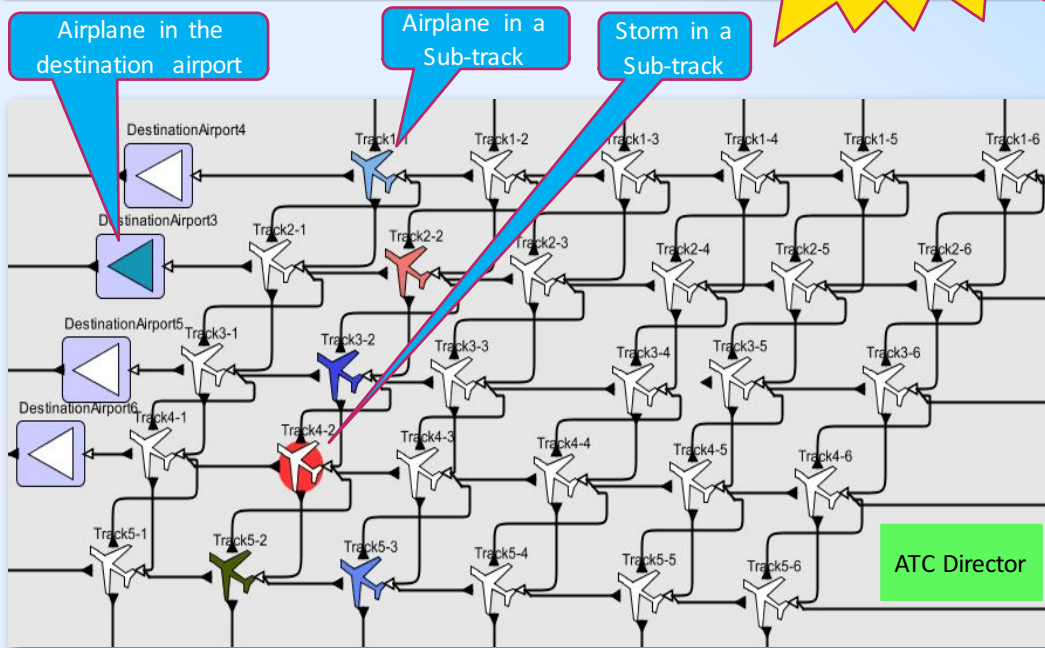
**Air Traffic Control system (ATC)** is a Safety Critical Cyber Physical System where the people in charge are constantly dealing with various kinds of **changes** in the environment and the system, like unpredicted changes in the **weather** or changes in the **flight schedules**.

Current systems are far from being able to handle the changes in a fully automated and integrated way.

**ATC** has been modeled using **Ptolemy** to check the **safety properties** and analyze different **rerouting policies** to find a safe and more efficient rerouting policy.

Make fully automated Air Traffic Control SAFE!!

## ATC in Ptolemy



North Atlantic Organized Track System

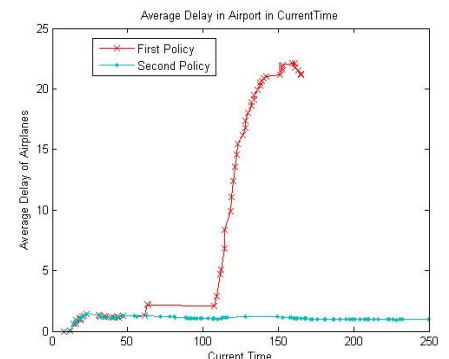
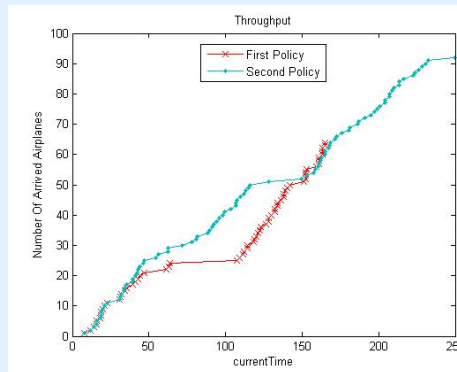
## MODEL DESCRIPTION

- ✓ 5 parallel Tracks & each Track is partitioned to 6 sub-tracks.
- ✓ 100 airplanes, with a predefined flight plan, speed and fuel.
- ✓ 10 destination airports and 1 source airport.
- ✓ ATC Director as an extension of the DE Director.
- ✓ Modeling each sub-track as an actor and airplane as a token traveling through sub-tracks.
- ✓ Rerouting airplane considering its remaining fuel, storm in a sub-track and legitimate distance between two airplanes.
- ✓ Considering airports capacity, taking off and landing time of airplanes.
- ✓ Considering traveling time in sub-tracks.

## EXPERIMENTAL RESULTS

Measured parameters:

- Flight duration for each airplane.
- Delay of each airplane in the airport.
- Average flight duration.
- Average delay of airplanes in the airport.
- Number of airplanes arrived at their destination (Throughput).
- Delay of airplanes in each sub-track.
- Number of airplanes traveling through each sub-track (Load of sub-track)



Two implemented **policies** for **rerouting** the airplanes

- First policy: Local search to find a new route for airplane.
- Second policy: Dijkstra algorithm to find shortest path as the new route.

**Deadlock and safety issues are checked.**

**ATC is the case study of a larger project for designing reliable self-adaptive actor systems.**