Traffic Predictions
Supporting General Aviation

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Motivation

- Help GA pilots staying well-clear of surrounding traffic
- Display current/future traffic data on moving map apps
- Expected favourable safety effects
- Mitigate the limitations of see-and-avoid principle
Flight Intent

- Sequence of straight legs that the pilot plans to fly
- Many commercial apps can help the pilot with this planning phase
- Due to external factors, the realisation of a flight may substantially differ from the intended route

Four Kinds of Uncertainty

- Aircraft Kinematic State
- Leg Adherence
- Flight Intent Adherence
- Flight Intent Availability

Scales:
- Meters
- $10^3$ m
- $10^5$ m
Aircraft Kinematic State
State-based Prediction

$x_t$: aircraft state (e.g. position and speed)
$z_t$: “noisy” observation of $x_t$

Prediction Phase:

$x_{t+1} \mid z_t$

Update Phase:

$x_{t+1} \mid z_{t+1}$

New observation $z_{t+1}$ available

Observation model: $z_t \sim x_t$

Dynamical model: $x_{t+1} \sim x_t$
Leg Adherence

Image courtesy of Claude Le Tallec, Onera
Flight-Intent Adherence
Flight-Intent Availability

http://www.visualsoft.co.uk/ecommerce-blog/wp-content/uploads/2011/05/share-button1.jpg
Prevailing Uncertainties

- Aircraft Kinematic State
- Leg Adherence
- Flight Intent Adherence
- Flight Intent Availability

10 seconds, $10^2$ seconds, $10^3$ seconds
Flight-Intent Replacement
Mining GA Typical Paths

Kernel Density Estimation of Airspace Occupancy from GNSS traces flown between LFPZ and LFPD
Mining GA Typical Paths

A turning-point analysis enables paths classification
Experiments

Image courtesy of Hans Brandts, NLR
Experiments
Experiments
Experiments
Experiments
Experiments
Conclusions

• Aircraft state + flight intent = intent-based prediction

• Preliminary testing suggests approach is valuable

• How to fruitfully visualise long-term predictions?

• May the data-driven approach alone define an exhaustive description of typical GA paths?
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