Session One
Conflict Detection & Resolution
Decision Support Tools

Rapporteurs

Daniel Delahaye

Jim Dieudonné

Session One Participants

- *G. J. Bakker, NLR*
- *Jos Beers, EC/NLR*
- *Dan Brudnicki, CAASD*
- *Daniel Delahaye, CENA*
- *Jim Dieudonne', CAASD*
- *Nicolas Durand, CENA*
- *Heinz Erzberger, NASA*
- *Ingrid Gerdes, DLR*
- *Robert Graham, EEC*
- *Koen de Jong, NLR*
- *Peter Jorna, NLR*
- *Barry Kirwan, NATS*
- *H. J. Kremer, NLR*

Session One Participants

- *Dennis Lawson, FAA*
- *Marcel Leroux, CENA*
- *Colin Meckiff, NATS/EC*
- *Andy Price, NATS/EC*
- *Harry Swenson, NASA*
- *Alex Vink, EC/NLR*
- *Craig Wanke, CAASD*
- *Anthony Warren, Boeing*

Session One Summary (1/6)

- *Conflict Resolution*
  - *Keep "Humans In The Loop" BUT*
    - *What is the Human's Role?*
    - *What is the Machine's Role?*
  - *Problem Must Be Solved Globally*

Session One Summary (2/6)

- *Theoretical Aspects*
  - *Deterministic Solution to 2 Aircraft Problem*
    - *Optimal Control*
    - *Conflict Probe (Erzberger)*
    - *Optimal Control & Game Theory (Sastry)*
  - *Larger Aircraft Clusters result in Combinatorial Explosion*
    - *Stochastic Optimization Shows Promise (Durand)*

Session One Summary (3/ 6)

- *Theoretical Aspects (continued)*
  - *Future Research Needed on Mixing Optimization Methods*
  - *Constantly Increasing Computer Power Requires Us to Revisit Previously Discarded Methods*
  - *Methods to Determine "Solution Robustness" Needed*

Session One Summary (4/6)

- *Constuction of Conflict Free Routes (Gerdes)*
- *Conflict Probe*
  - *Two Types applied*
    - *Geometric (MTCD, URET)*
    - *Stochastic (CTAS, PHARE, URET)*

Session One Summary (5/6)

- *Free Routing*
  - *"The Airspace Is Still Empty"*
  - *Fewer Conflicts --- Harder to Detect --- How can We Manage This Traffic???*
  - *"Dynamic Density" Indicator Needs Development*
  - *Simulations and Statistics of Traffic Complexity needed for Airspace Operations Design (Warren)*

Session One Summary (6/6)

- *Free Routing*
  - *Transition Requires Research into "Dynamic Organized Airspace with Virtual Fix" (Dynamic Resectorization or Route Design)*

Session One Recommendations

- *Research Priorities (Near Term)*
  - *Move Conflict Probe into Implementation*
  - *Increase use of "Field Testing" for Validation & Verification of R&D Efforts*
    - *Has worked very well in USA*
  - *Use EATCHIP "Human Machine Interface" Design as Standard for Future Efforts*
  - *Trajectory Prediction*
  - *HIPS as possible capacity enhancer!*

Session One Recommendations

- *Research Priorities (Long Term)*
  - *Conflict Resolution*
  - *Changes in Roles & Responsibilities*
    - *Human Factors*
    - *Training*
  - *"Dynamic Density"*
  - *Safety Models*

Session One Collaboration Opportunities

- *Oceanic HIPS*
- *Conflict Resolution*
- *Trajectory Prediction*
- *Human Factors in ATM Design*
- *Airspace Organization & Design*

Session One
Research Conclusions

- *Agreements*
  - *Conflict Probe Research is Mature*
  - *Sharing Information Is Useful*
  - *Focus Efforts to Finish Research to move quickly into Implementation*
    - *SMA, TMA, URET*
  - *Use Operational Field Trials of R&D Systems*
    - *MTCD*

Session One
Research Conclusions

- *Disagreements*
  - *Is "Free Flight" Useful?*

Backup Material

Presentations Summaries

- *User Request Evaluation Tool*
  - *Field Evaluation*
    - *See "Summary of Findings"*
    - *Def. of "Trajectory Model"??*
    - *See "Functional Performance" chart*
  - *Benefits*
    - *Potential of up to $620M savings*

Presentations Summaries

- *HF in ATM System Design Life Cycle*
  - *More support to Operational Centers*
  - *HF Integration into ATM Life Cycle*
    - *See Table 5*
  - *Benefit is "adaptive high reliability"*

Presentations Summaries

- *Surface Movement Advisor*
  - *Atlanta Prototype*
  - *System Design Teams*
    - *Ops Reqs Summary (see chart)*
  - *Overall 2min reduction in taxi times*
    - *Secondary benefits (difficult to measure)*
  - *Predict "Gate Conflicts"*

Presentations Summaries

- *Traffic Management Advisor*
  - *Evaluation at Dallas/Ft. Worth (DFW)*
  - *Avg.. Airport Acceptance Increased 5%*
  - *Delay Reduction of 70 sec mean*
  - *30% reduction in delay distribution*
  - *Next Steps*
    - *Info Sharing with Airlines*
    - *Move delays further out (options}*

Presentations Summaries

- *Human Machine Interfaces*
  - *ATM HF Testbed*
    - *Data Link (DL) HMI Development*
    - *Movement toward Data Block Integration*
    - *Objective & Subjective Measures Differ Greatly*
    - *Transition to New Technology needs carefully designed evolution path*
  - *Overall Experience*
    - *"High Traffic Panic", "More Tools - More Work"*

Presentations Summaries

- *"Conflict Awareness not Traffic Awareness"*
- *"Free Flight means "Fragmented Picture"*

- *Issues*
  - *Controller skills must change for capacity increase*
  - *Move to "quickly getting the picture" from "maintaining the picture"*

Presentations Summaries

- *Oceanic HIPS*
  - *CR Tool Designed to keep Human In Loop*
    - *Manoeuvre Surface*
    - *"No Go Zones"*
    - *Good Acceptance by the Controllers*
  - *Separation Standards Problem*
    - *"Track Separation" instead of "Aircraft Separation"*
  - *Productivity, Quality Increase*

Presentations Summaries

- *Harmonisation of HMI*
  - *Color*
    - *Defined by "Aircraft/Controller State"*
  - *Dynamic Graphic Interaction*
    - *Shape of "Label"*
  - *Traj & CP Information*
    - *Conflict Risk Display*
  - *System Assisted Coordination*
    - *Coordination by Exception*

Presentations Summaries

- *ERATO*
  - *Need for Cognitive Models*
  - *Effect of "Technology" on Cognitive Mgt.*
  - *Aircraft to "Effecting Subgroup"*
    - *Algorithm for "Effecting Subgroup" Determination*
  - *Test Results*
    - *Improving Cognitive Management is main source of productivity*

Presentations Summaries

- *Probabilistic vs Geometric CP*
  - *Comparison of one Geo and two Prob CPs*
    - *Conflict Probability (NASA)*
    - *Collision Risk Probability (NLR)*
- *{By proper chose of parameters all three methods converge}*
  - *NLR method currently untested, but shows promise and should be pursed*

Presentations Summaries

- *Hybrid Control Issues in ATM Systems*
  - *Use of "Formal Methods" for Cert*
  - *Technology need of Methods to cut down cost of SW certification (V & V)*
  - *Road Designer's were correct, "Traffic Circle" is the answer!!*
  - *JED's Idea, "Put Traffic Circles at Corner Posts"*

Presentations Summaries

- *Methodology for Free Flight Transition*
  - *Application of Covariance Method to determine Operational Requirements of Free Flight*
  - *Changes in Roles & Responsibilities for Separation Assurance Time Partitioning*
  - *Operational Concepts Modelled using TAAM*

Presentations Summaries

- *Simulation Results*
  - *Start with Baseline, move the RVSM, then reduce separation standards and move to UPT & RVSM*
- *Provides System Requirements for*
  - *Surveillance*
  - *Navigation*
  - *Track Accuracy Requirements*
  - *ADS-B for Vertical Path*
- *Great Summary*

Presentations Summaries

- *CP using Air/Ground Data Link*
  - *User Benefit Restricted by accuracy of predicted trajectories*
  - *Use of supplementary data sources to improve trajectory prediction*
    - *Aircraft state*
    - *Local Met data*
    - *Better Flight Plans from Airline Operations*

Presentations Summaries

- *Free Flight Evaluation System*
  - *Use of ACARS from UPS, UAL, DAL*
  - *Wind Error*
- *Results show improvement in accuracy of trajectory model and reduction in "reconformance" of trajectories*

Presentations Summaries

- *Medium-Term Conflict Detection (MTCD)*
  - *Up to 20 mins ahead, flight data*
  - *Executive Control "limiting today's ATC"*
  - *MTCD reduces conflicts by 30%*
  - *Ready for movement into field*

Presentations Summaries

- *Genetic Algorithms Construction of Conflict-Free Routes*
  - *Concept and Theory Stage*
  - *Application of Evolutionary Algorithm*
  - *Tests Results are Positive*
    - *Need to move to RT Simulations (Planned)*

Presentations Summaries

- *Conflict Probing & Resolution with Errors*
  - *Design should design to entire airspace*
  - *"Active Control" reduces "Error Probability"*
  - *Numerous Applications of CP*
  - *Very Stable Algorithms & SW Arch*
  - *Large Amounts of field test data*

Presentations Summaries

- *Optimal Conflict Resolution*
  - *Genetic Algorithm Implemented in RT ATC Sim*
  - *Realistic Maneuvers Derived*
  - *Speed Changes Not Modelled*
  - *Applied to complete day sim of France*
    - *All conflicts solved*
    - *Ability to deal with RT system (still to be done)*