Airspace Management

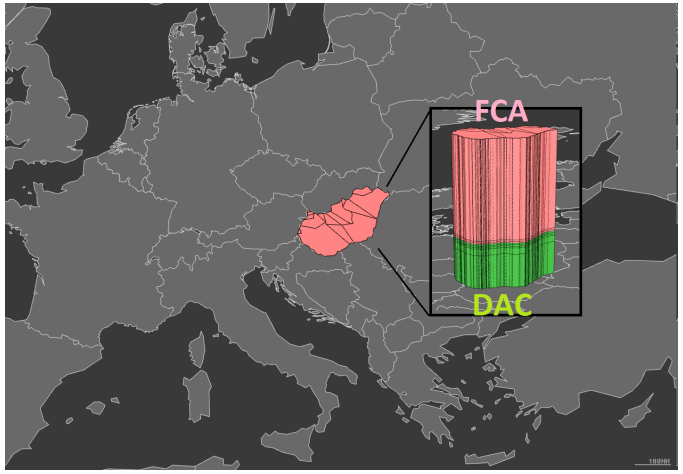
ATS route based airspace configuration

The current airspace management is mainly based on the ATS routes. The airspace configuration does not take into account the traffic complexity and the mental workload of the controllers.

Furthermore, the airspace management optimization process is not dynamic and does not consider the inherent demand uncertainty, which makes inefficient the whole DCB process.

Complexity based airspace configuration

COTTON DAC Solution builds on dynamic design of the airspace providing an accurate adaptation of the capacity to the foreseen demand. COTTON FCA Solution builds on a sector-less environment where each aircraft entering the FCA area is allocated to an ATCo taking into account trajectory based complexity and demand uncertainty. On top of that, COTTON has developed DAC/FCA design criteria to decide, monitor and refine the sector boundaries delineating DAC and FCA areas.



COTTON has proven a better airspace management performance thanks to the incorporation of dynamicity, complexity and uncertainty.

Founding Members

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National Centre of Scientific Research
Athens , Greece

ATC Simulations

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SESAR Exploratory Research

Final Workshop

COTTON

Capacity Optimisation in TrajecTory-based OperatioNs

The present research addresses innovative ATM solutions for Demand and Capacity Balance, in particular Dynamic Airspace Configuration and Flight Centric ATC.

COTTON proposes Enhanced Complexity Management introducing demand uncertainty including the improvement of complexity metrics and their integration into the overall process.

COTTON DESCRIPTION

COTTON is building an integrated view on future Capacity Management (CM) processes by exploring how complexity assessment could help Dynamic Airspace Configuration (DAC) and Flight Centric ATC (FCA) solutions and their integration. COTTON takes advantage of trajectory information that is available in a TBO environment and incorporating the uncertainty in the DCB decision-making.

COTTON Solution proposes a Complexity Assessment, which is flexible enough to support each CM sub-process in each time horizon, with the due granularity to address the specificities of DAC and FCA airspaces.

Three Fast Time Simulation exercises with involvement of operational expert support have been carried out to demonstrate COTTON Solution improvements with the following conclusions:

Capacity Management Environment	Conclusions
FCA	Allocation strategies based on COTTON Enhanced Complexity have showed a better balance of ATCo Workload.
DAC	DAC shows that the application of complexity metrics better adapted to a trajectory-based environment allows a sector configuration plan more adapted to the traffic demand, reducing the risk of imbalances.
Integrated DAC/FCA	DAC/FCA boundary delineation processes with the support of COTTON Enhanced Complexity is defined with sufficient level of detail to demonstrate its technical and operational feasibility and demonstrated a reduction of overloads.

ATC simulations have been driven to show ATCO's response in DAC and FCA to different Complexity Generators from a physiological point of view, measuring Electroencephalography, Video-based-eye-tracker and pulse plethysmography.

COMPLEXITY METRICS

COTTON has assessed the suitability of the complexity metrics to support DAC, FCA, and integrated DAC/FCA CM process.

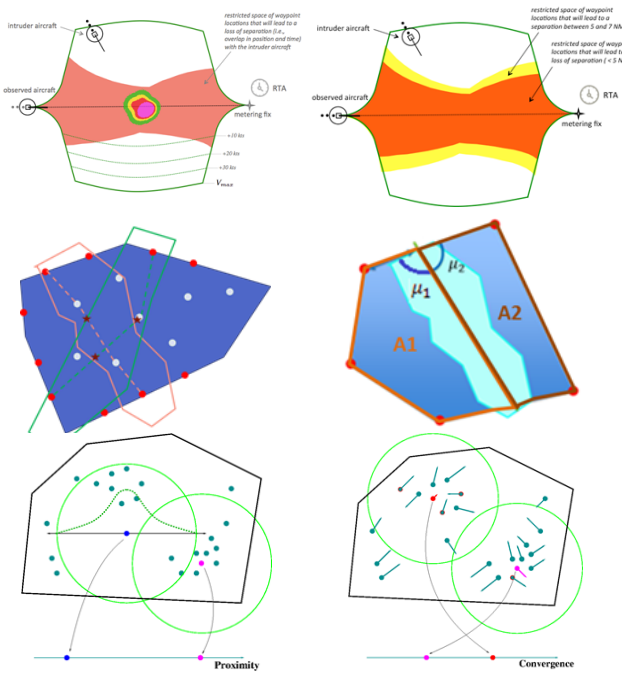
Three candidate complexity metrics, namely Solution Space, Cognitive Complexity and Geometrical Complexity have been selected. Their mathematical formulation has been evolved and complexity-based methods have been developed to assess capacity in DAC and FCA.

COTTON has integrated the demand uncertainty and defined the method to identify the value of the capacity thresholds.

Solution Space
- Aircraft manouvering space

Cognitive
- Mental abstractions
- Sector shape factors

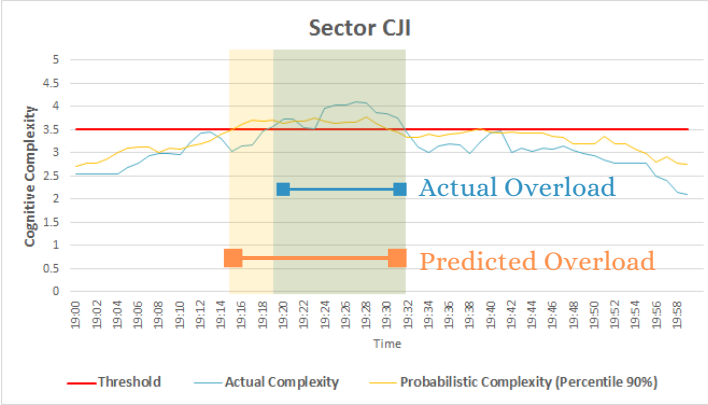
Geometric
- Aircraft Proximity
- Aircraft Convergence



CAPACITY MANAGEMENT

The development and integration of COTTON Complexity Assessment within the Capacity Management processes constitutes COTTON Enhanced Capacity Management.

COTTON proposes probabilistic complexity as a tool to adapt the confidence index to the forecast horizon and the ANSP strategy.



USE CASES

COTTON Enhanced Capacity Management comprises the development of the following use cases.

DAC Use Cases
- Identify number of sectors
- Identify sector configurations
- Identify remaining hotspots
- Run simulation with sector configuration
- Run simulation with alternative sector configuration
- Assess impact on agreed sector configurations and ATFCM measures

FCA Use Cases
- Planning of # of CWP
- Opening and closure of CWP
- Allocation of Traffic entering the FCA

Integrated DAC/FCA Use Cases
- Delineate daily DAC and FCA areas and Opening Schemes
- Assess FCA/DAC opening scheme cost effectiveness
- Change FCA/DAC boundaries
- Assess and organize coordination between DAC and FCA transition