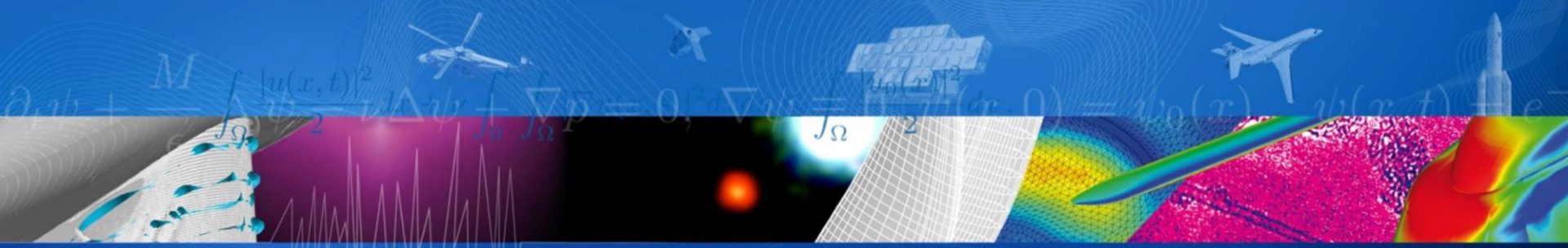

Adaptive Structuring of Unmanned Traffic: A UTM Concept

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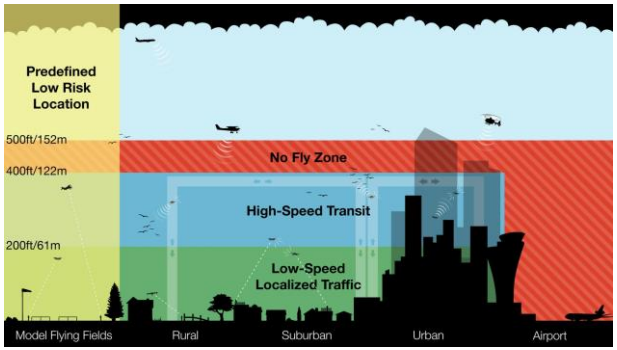
Context

Motivation:

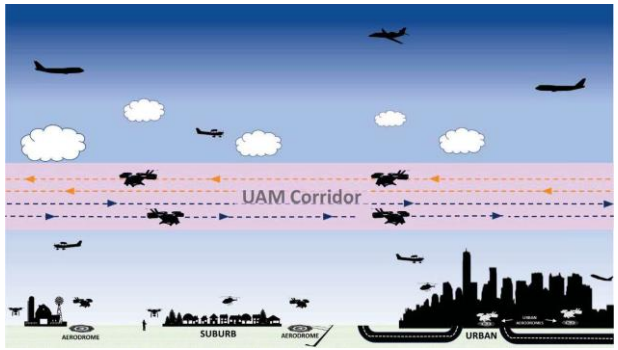
- The growing demand for Urban Air Mobility (UAM) air vehicles brings new challenges to urban airspace in the near future
- This demand is likely to cause congestion, high traffic complexity, and safety issues

Objective:

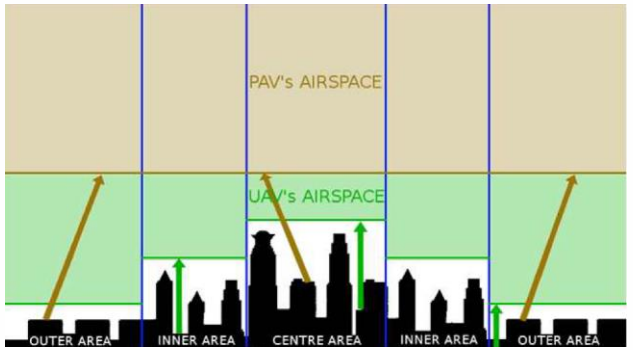
- To integrate UAM operations in the current air transport system by Unmanned Traffic Management (UTM)
- To develop air traffic assignment model in order to auto-structure the airspace and manage the intensive air traffic flow with the support of automated UAM operations in multi-layer two-way route network



Urban airspace concept by Amazon



UAM corridor by FAA

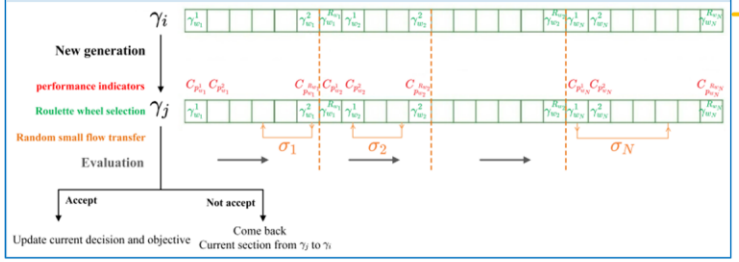


Metropolis project by TU delft

Methodology

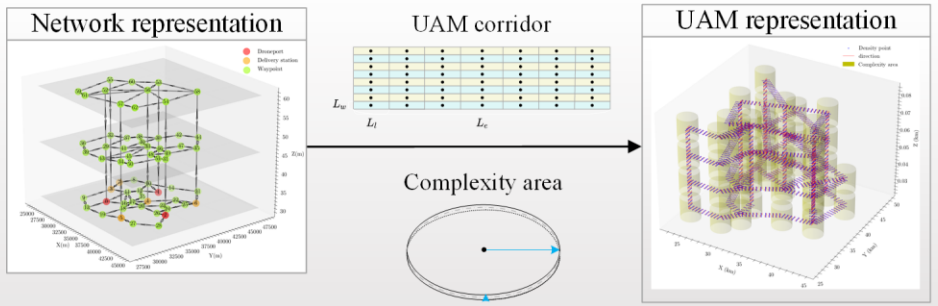
Initialization module

- Heat-up process
- Cooling process
- Distributed neighbor generation based on the cost of nodes connecting the path



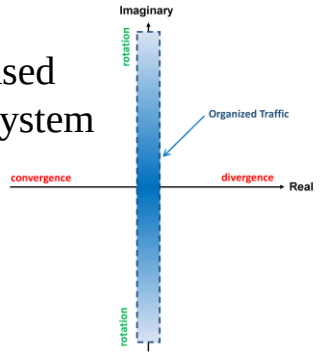
Data

Simulation module



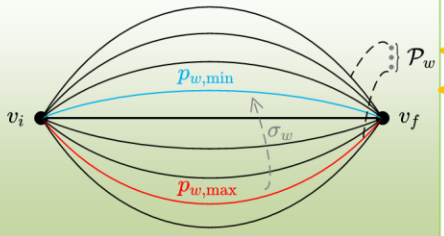
Decision variable γ

Objective function based on linear dynamical system



Optimization module

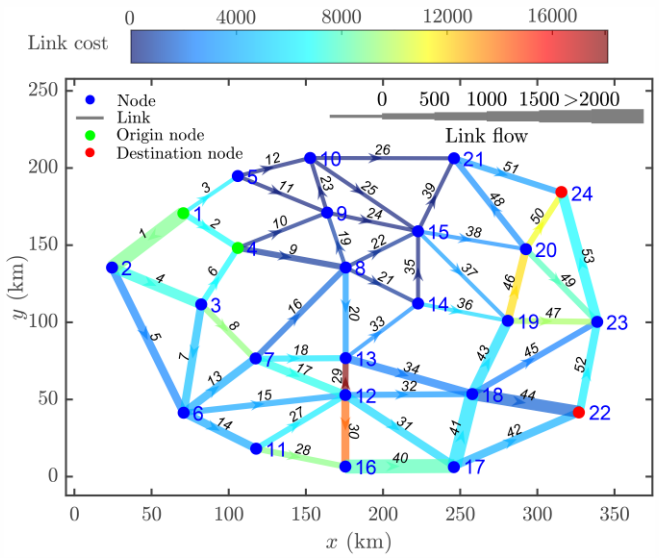
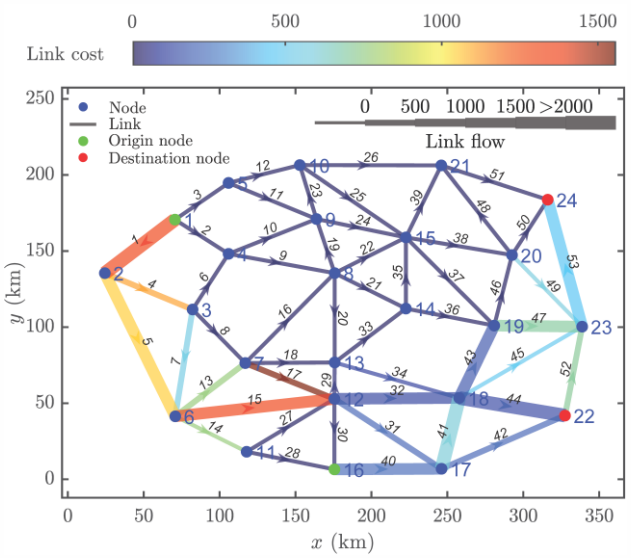
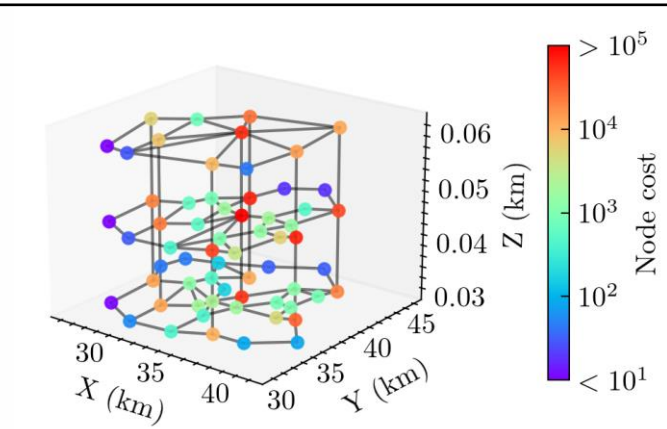
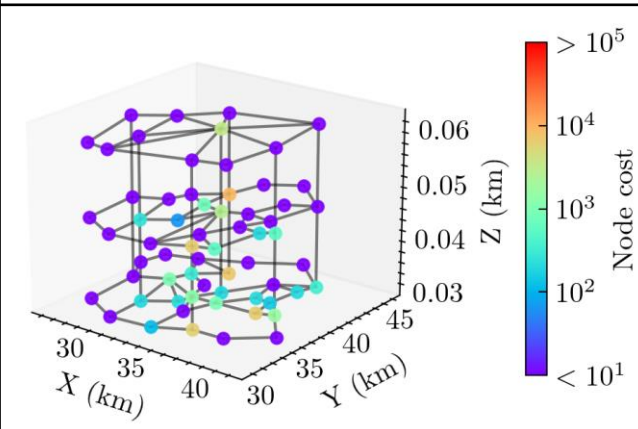
- Dafermos' algorithm



Performance indicator

$\{C'_p\}_{p\in\mathcal{P}}$

Results

	Initial state	After optimization
2D route network		
3D route network		

Contribution and publication

Contribution:

- A novel macroscopic problem formulation for air traffic assignment in UAM operations
- An efficient representation of air transport network for UAM
- An intrinsic air traffic complexity metric based on linear dynamical system and flow congestion indicator
- A two-phase optimization procedure on the basis of SA and DA
- Application and comparative study on an air transport network in Singapore's urban airspace

Publication:

1. Zhengyi Wang, Daniel Delahaye, Jean-Loup Farges and Sameer Alam. Dynamical traffic assignment in low-altitude urban airspace for UAM operations, **In preparation** as a journal paper, 2022.
2. Zhengyi Wang, Daniel Delahaye, Jean-Loup Farges and Sameer Alam. Route Network Design for Future Urban Air Mobility Operations. **In submission** for International Conference on Research in Air Transportation (ICRAT), 2022.
3. Zhengyi Wang, Daniel Delahaye, Jean-Loup Farges and Sameer Alam. Complexity Optimal Air Traffic Assignment for Multi-layer Transport Network in Urban Air Mobility Operations. Transportation Research Part C : Emerging Technologies, **under review**, 2021.
4. Zhengyi Wang, Daniel Delahaye, Jean-Loup Farges and Sameer Alam. Air Traffic Assignment for Intensive Urban Air Mobility Operations. Journal of Aerospace Information Systems, 2021, 18(11) : 860-875.