Intelligent Optimization on Slots Negotiation in Collaborative Trajectory Options Program

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Outline

- Collaborative Trajectory Options Programs
- Challenges in the approach
- Single Game for CTOP (SG-CTOP)
- SG-CTOP Results
- Conclusion and future works

- CTOP came to improve not only the air traffic fluency but NAS' users business goals, handle with unknown challenges per flight and achieve better results considering airspace constrains and NAS' users preferences.
- In general, CTOP could be summarized as:
  - Given airspace constraints how achieve a better fluency flow considering capacity, improving business goal results for NAS' users and make possible to apply reroute and delay together.

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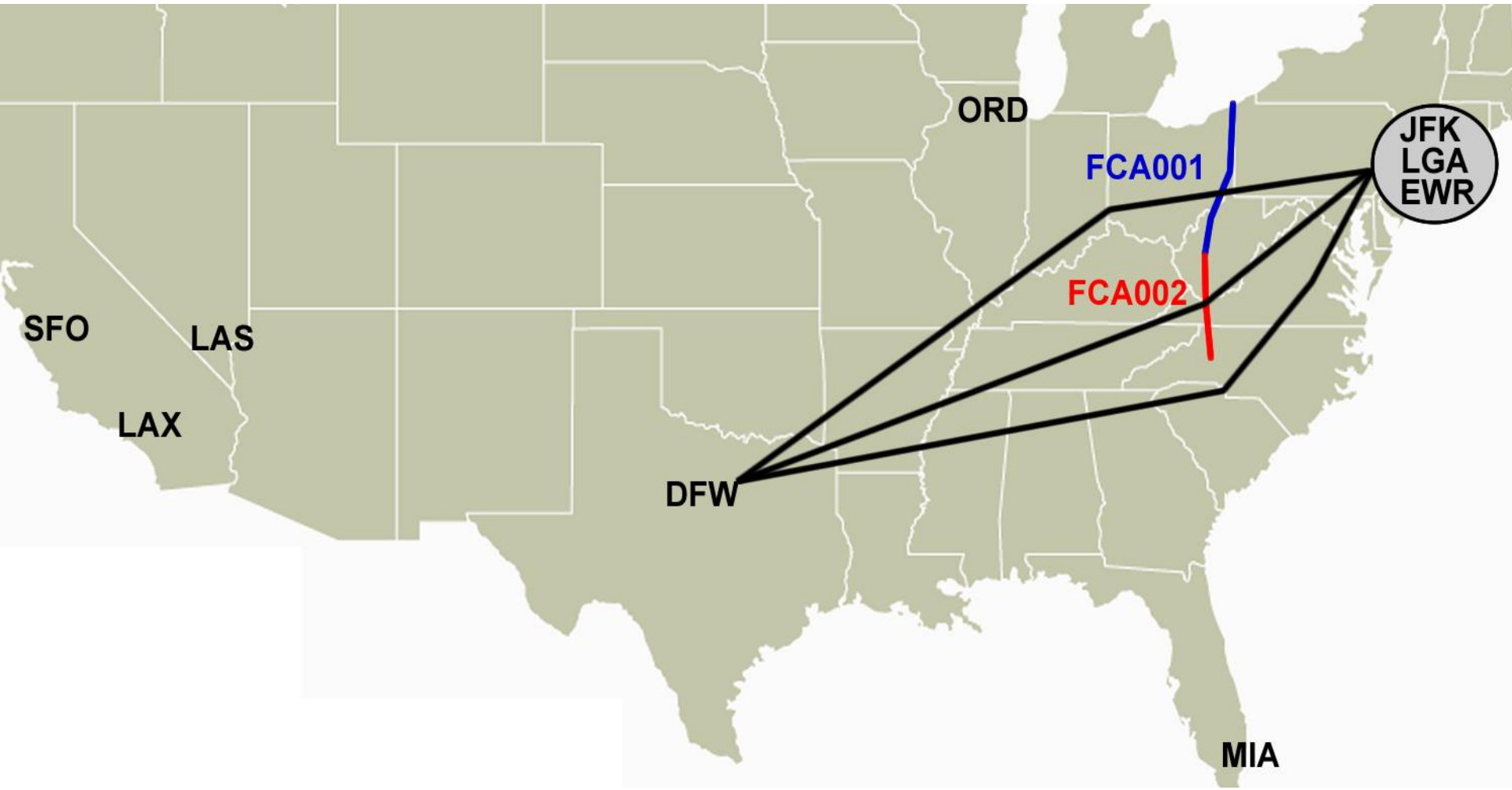
CTOP Overview



Challenges

- Optimize the TOS planning process with limited knowledge about each CTOP demand environment.
  - Flights, airlines and strategies

- Develop a model that work satisfactorily in most of cases, considering there is no information about competitors' CTOP captured flights and strategies.

	Airline B		
Airline A	NOSLOT (1054) NOSLOT (510)	NOSLOT (1054) 1 Trajectory + NOSLOT (513)	NOSLOT (1054) 2 Trajectories + NOSLOT (471)
	1 Trajectory + NOSLOT (1012) NOSLOT (510)	1 Trajectory + NOSLOT (1033) 1 Trajectory + NOSLOT (477)	1 Trajectory + NOSLOT (1102) 2 Trajectories + NOSLOT (489)
	2 Trajectories + NOSLOT (980) NOSLOT (510)	2 Trajectories + NOSLOT (1002) 1 Trajectory + NOSLOT (511)	2 Trajectories + NOSLOT (1007) 2 Trajectories + NOSLOT (481)

Case Study

- 100 different CTOP demands, called as SG-CTOP cycle
- 100 SG-CTOP cycles was performed
- CTOP period from 6 to 8 hours
- FCA capacity of 3 or 5 aircraft per 15 minutes
- Real data is composed of 331 flights
  - To New York metropolitan area
  - From Miami, Dallas, Chicago, San Francisco, Los Angeles and Las Vegas

Game Strategies

1. NOSLOT for all flights in every game
2. One trajectory plus NOSLOT option for all flights in every game
3. Two trajectories plus NOSLOT option for all flights in every game
4. Game move based on SG-CTOP's payoff function

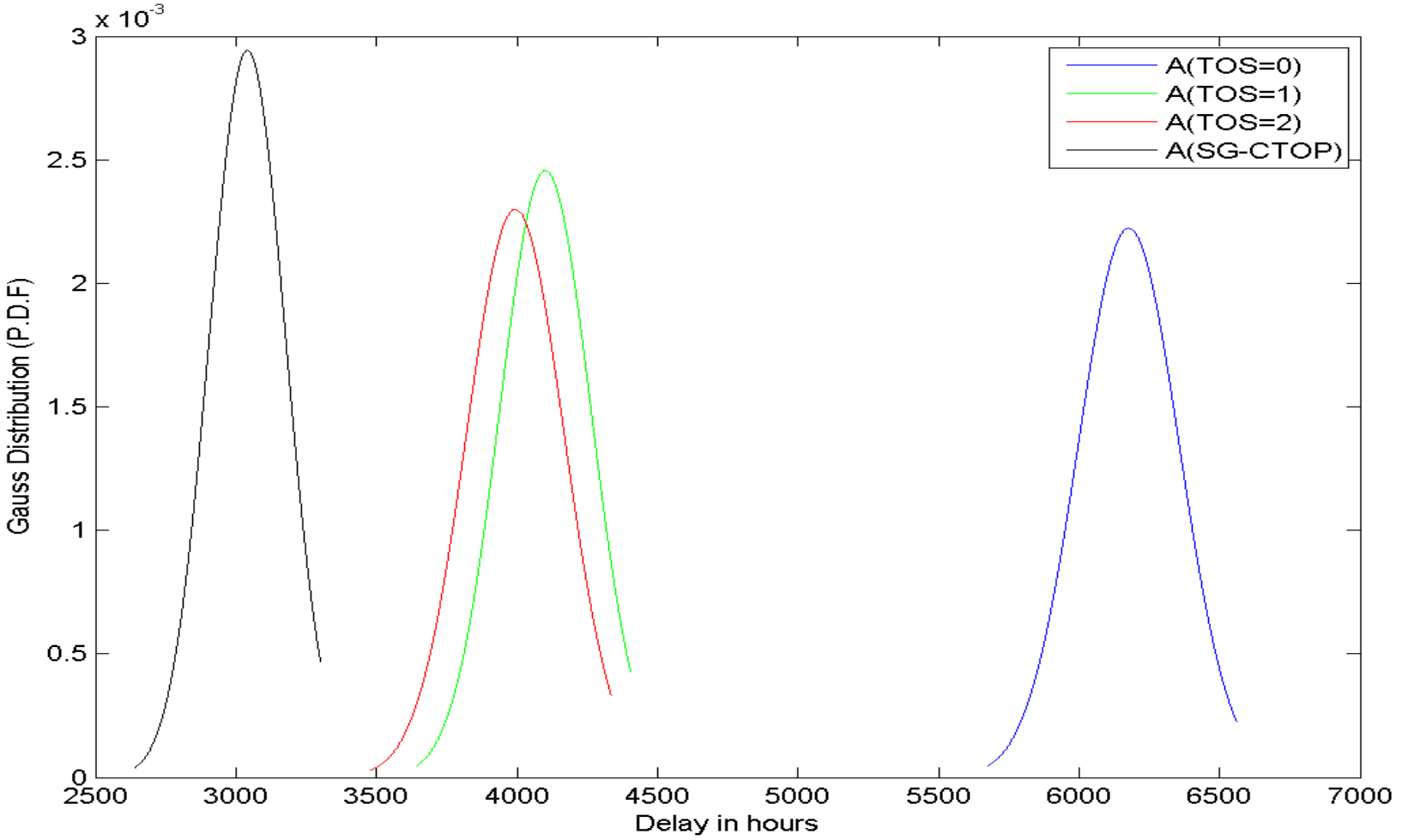
SG-CTOP Results

	TOS Strategies			
	NOSLOT	1 + NS	2 + NS	SG-CTOP
Delay in Hours (Case 1,2,3)	6149	4086	3950	3950
Delay in Hours (Case 1)	5196	3193	2992	2795
Delay in Hours (Case 2)	6960	4572	4479	4339
Delay in Hours (Case 3)	7791	5240	5182	4580

- It is possible to verify that SG-CTOP achieved a better, or equal, result in each possible case, from 0% to 14%, after one SG-CTOP cycle of 100 CTOP demands.

SG-CTOP Results

Case 1 for 100 SG-CTOP cycles



Conclusion

- After 100 SG-CTOP cycles the best strategy was achieved when it was sent two trajectories option for each FCA plus a NOSLOT option to fly around. This strategy achieved a global delay of 53% less than NOSLOT strategy.
- When this strategy was compared with the proposed SG-CTOP model, *Airline A* would achieve a global delay less than this strategy, or equal, in 97% of CTOP negotiations representing an reduction in accumulated delay of 537 hours for *Airline A*.

Thank You

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