A Data-driven Analysis of a Tactical Surface Scheduler

Aviation Technology, Integration, and Operations Conference
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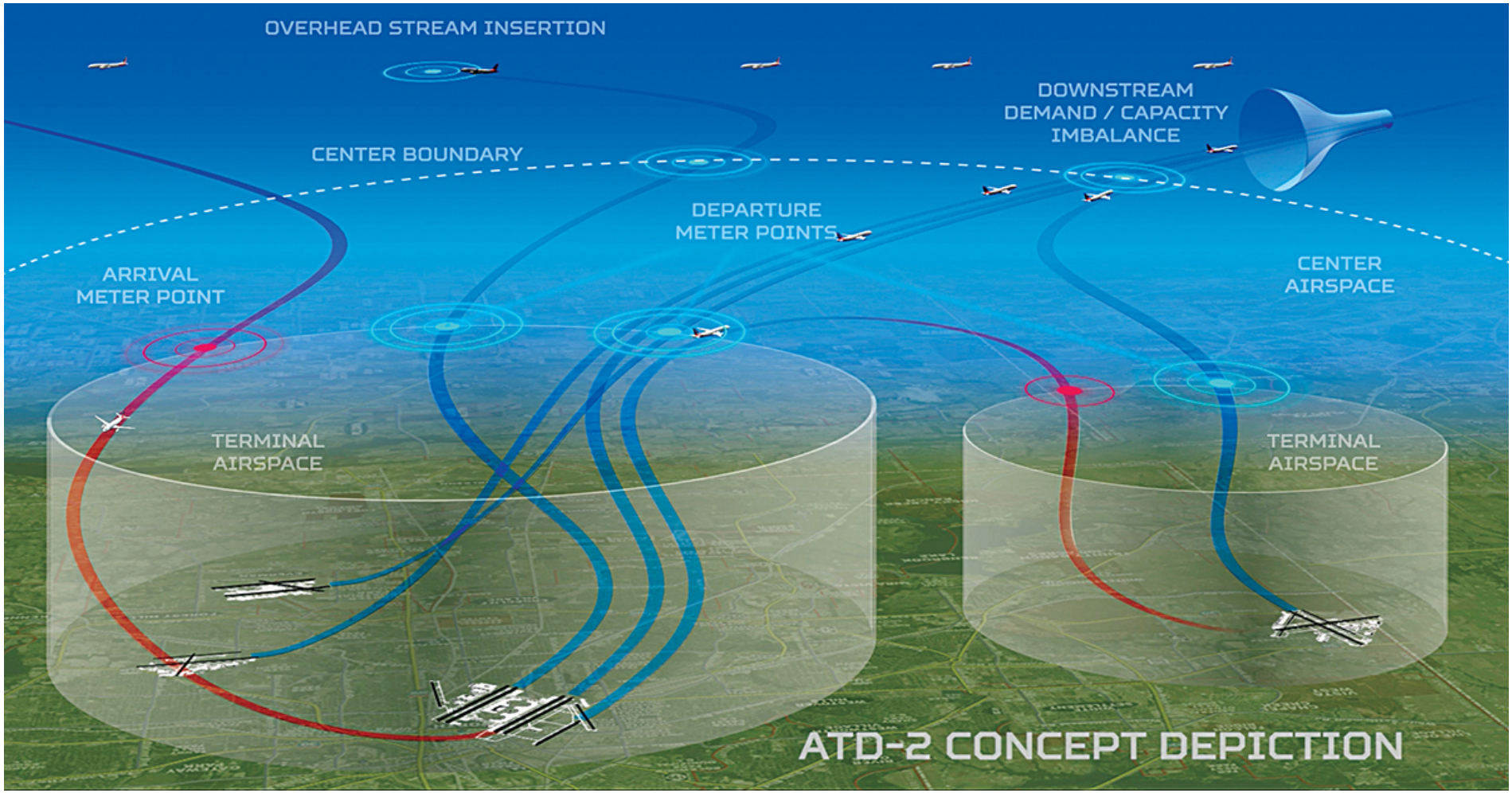
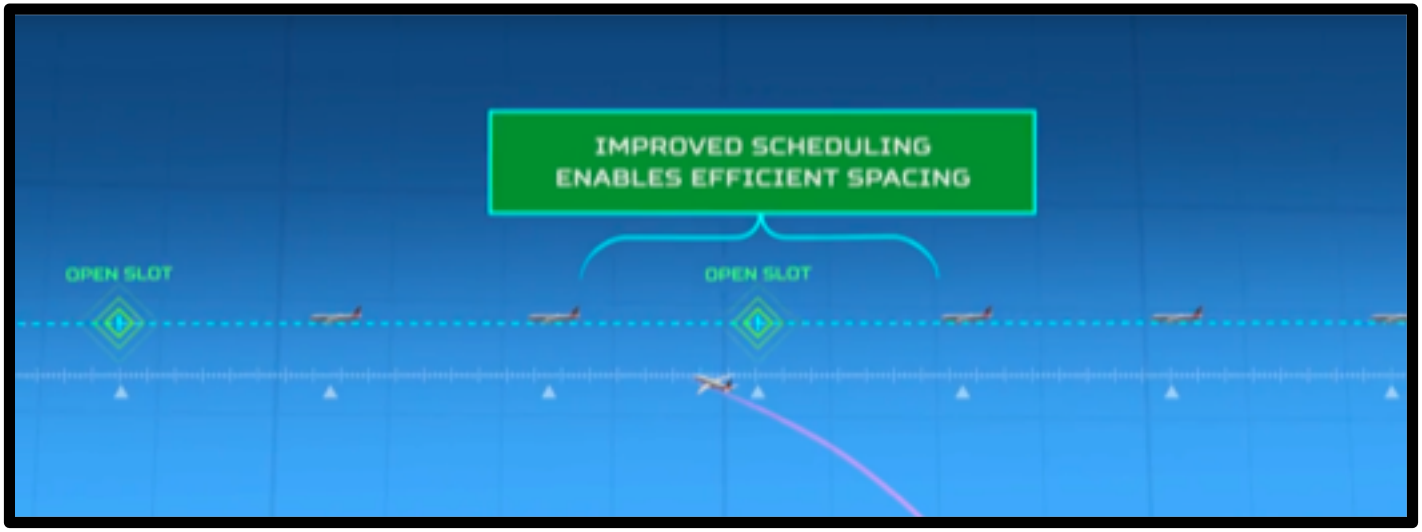
Introduction: ATD-2 Concept

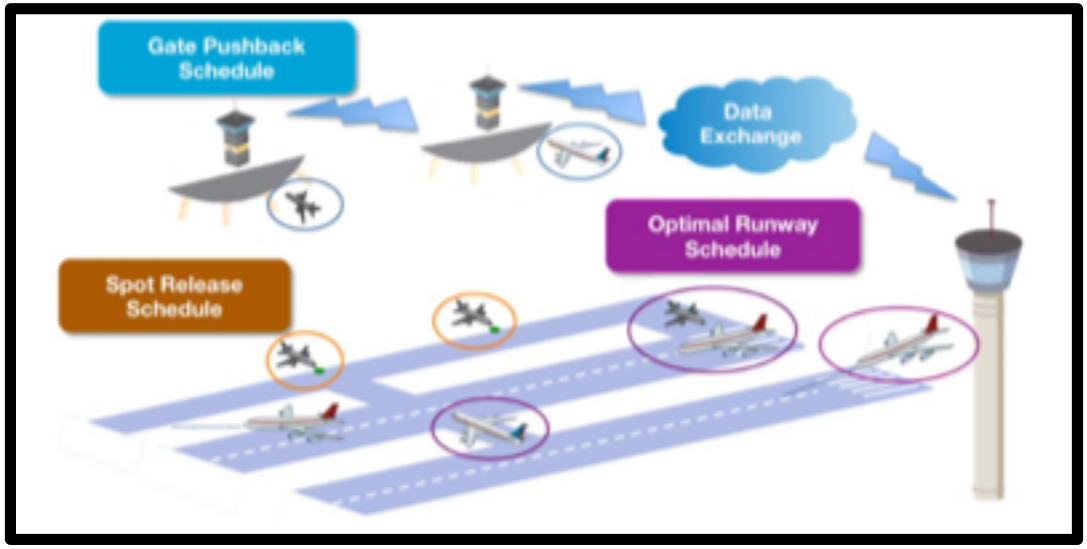


Introduction: Scheduling Concepts

Overhead Stream Insertion



Surface Metering



Motivation

Measure and assess the ability of the tactical scheduler to:

1. Balance demand with the available runway capacity

2. Generate accurate takeoff time predictions

Outline

- Background on ATD-2 IADS system at CLT
- Tactical scheduler design
- Balancing demand with available runway capacity
- Accuracy of TTOT predictions
- Challenges with scheduling in the tactical time frame
- Conclusions

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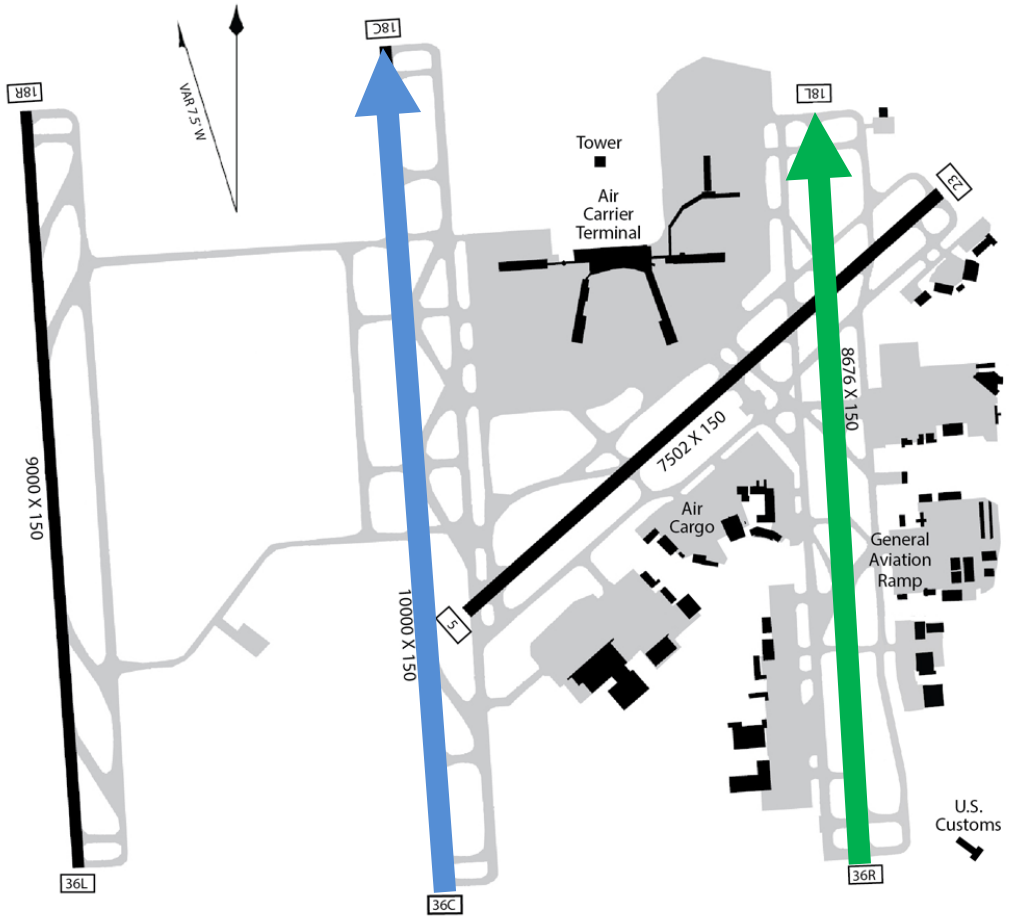
Background on ATD-2 at CLT



Runway 36C: Predominantly departure only runway

Runway 36R: Dual use runway accepting both departures and arrivals

Data collected from **live operational system** in bank-2 between 2018-03-01 and 2018-04-31

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Tactical Scheduler Design

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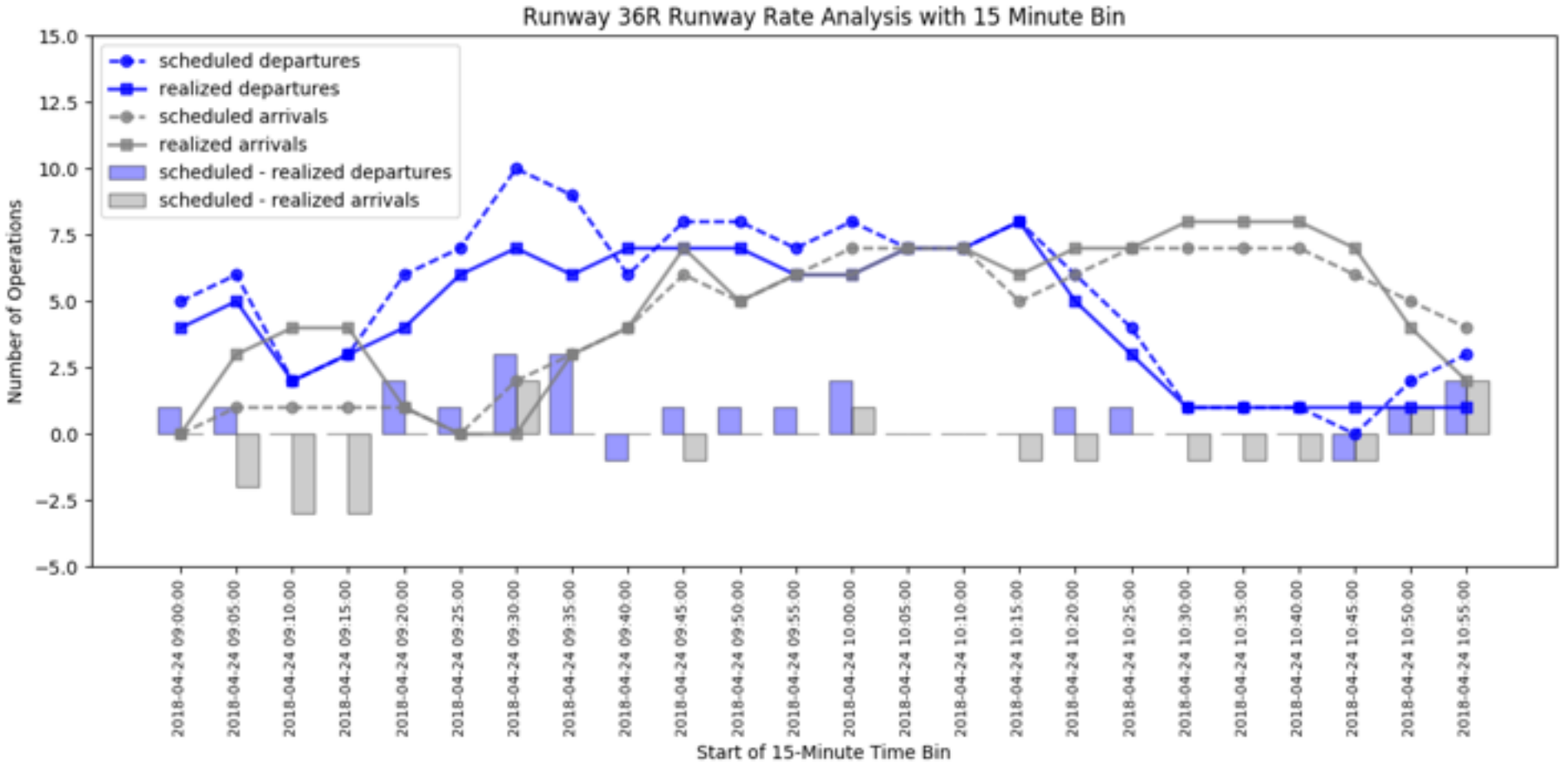
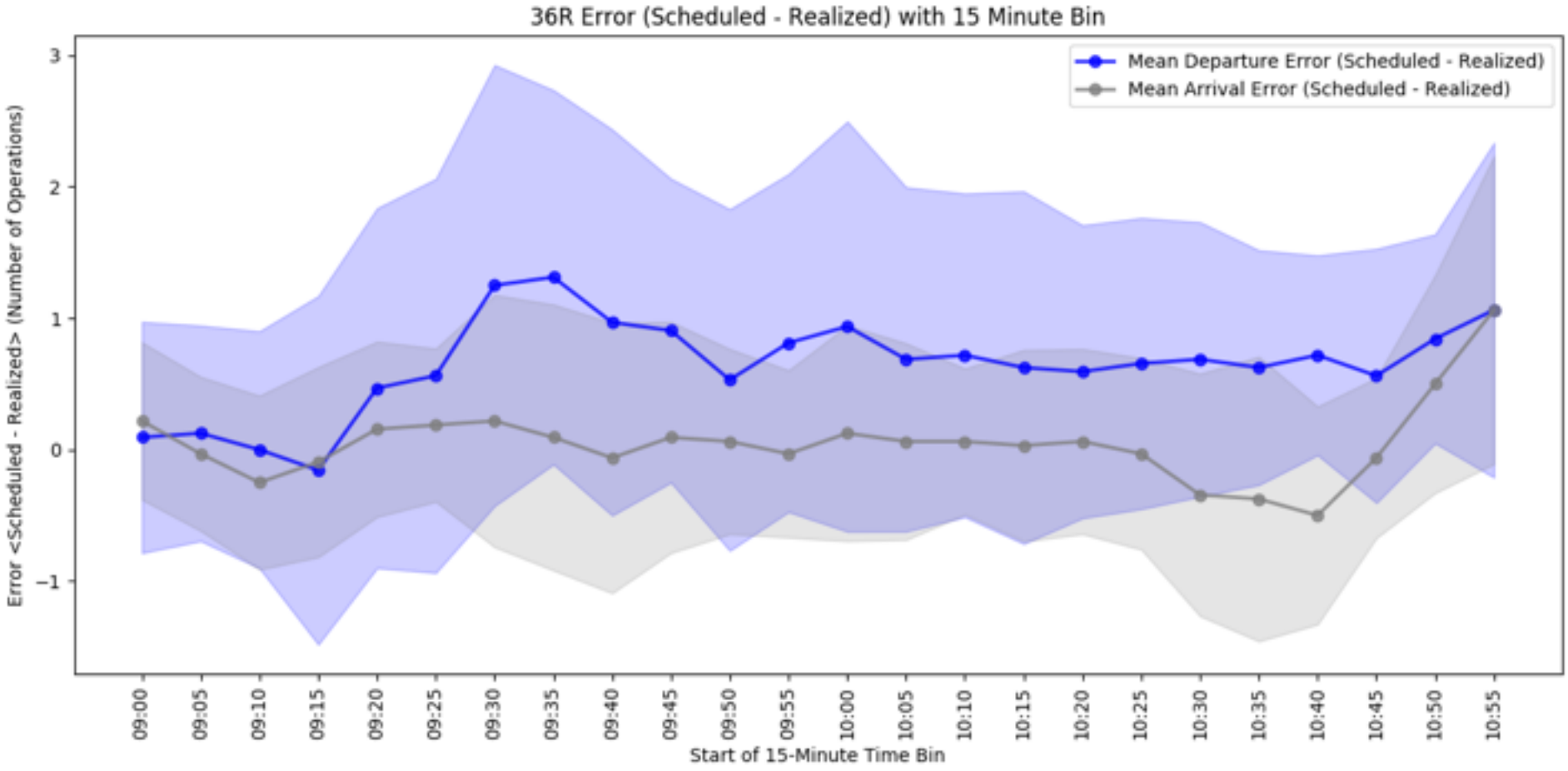
Balancing Demand and Capacity

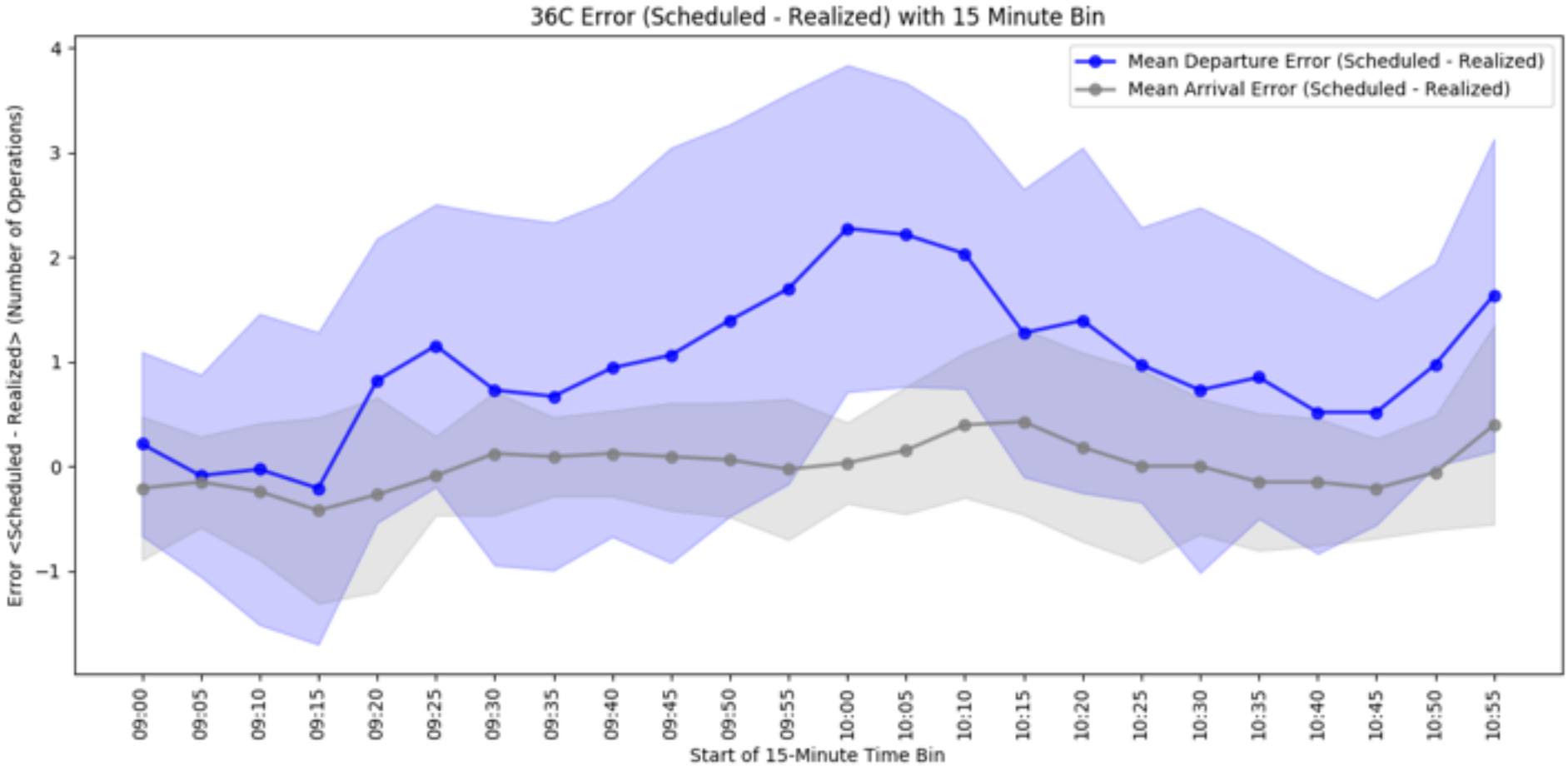


Balancing Demand and Capacity



We observe a slight bias of scheduling more operations than are realized in a 15-minute time period. For runway 36R we believe this is a result of missed opportunities to depart in an available slot between two arrivals.

Balancing Demand and Capacity



We observe a slight bias of scheduling more operations than are realized in a 15-minute time period. For runway 36C we believe this is a result of runway crossings which the wake vortex separation constraints do not model.

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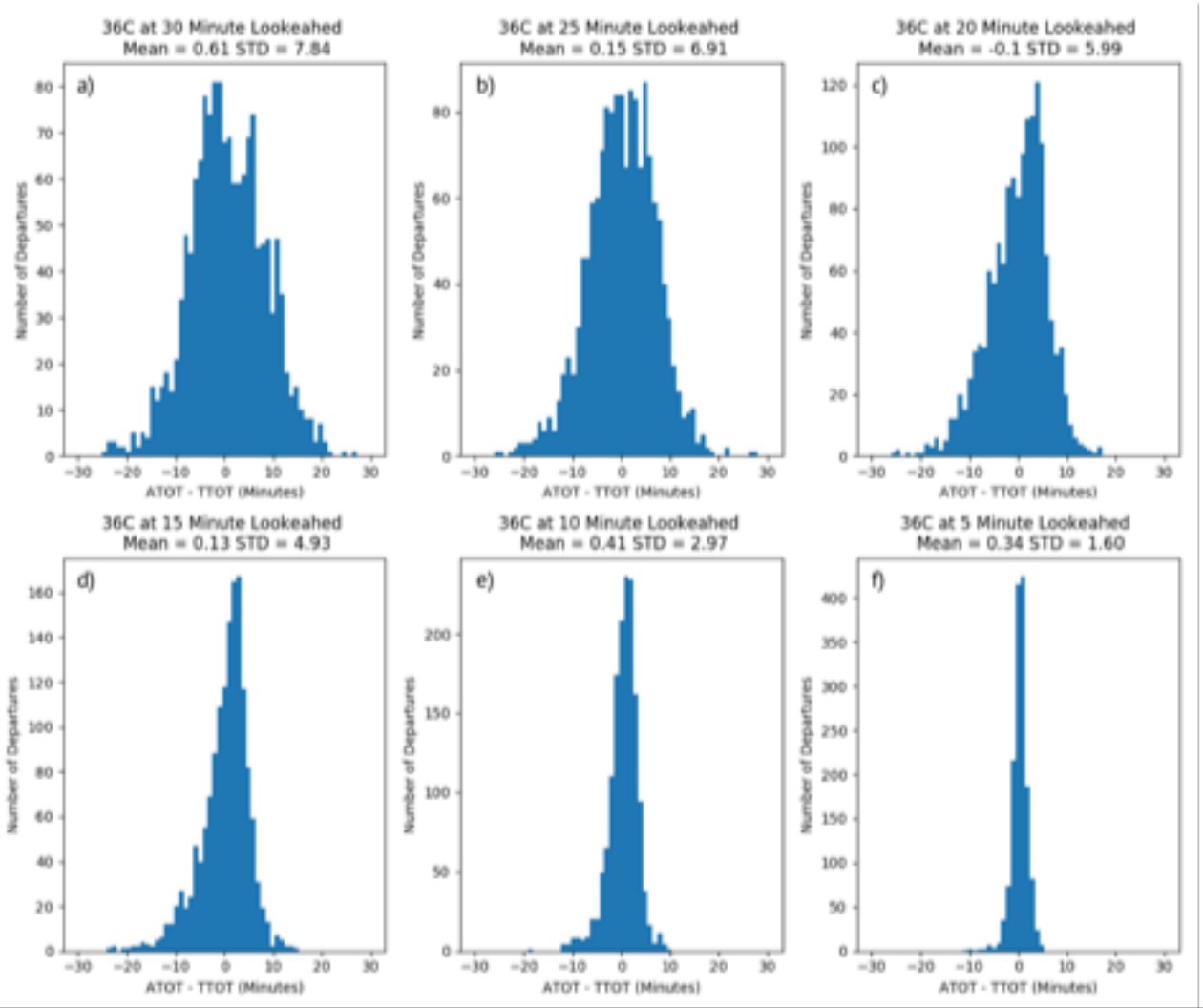
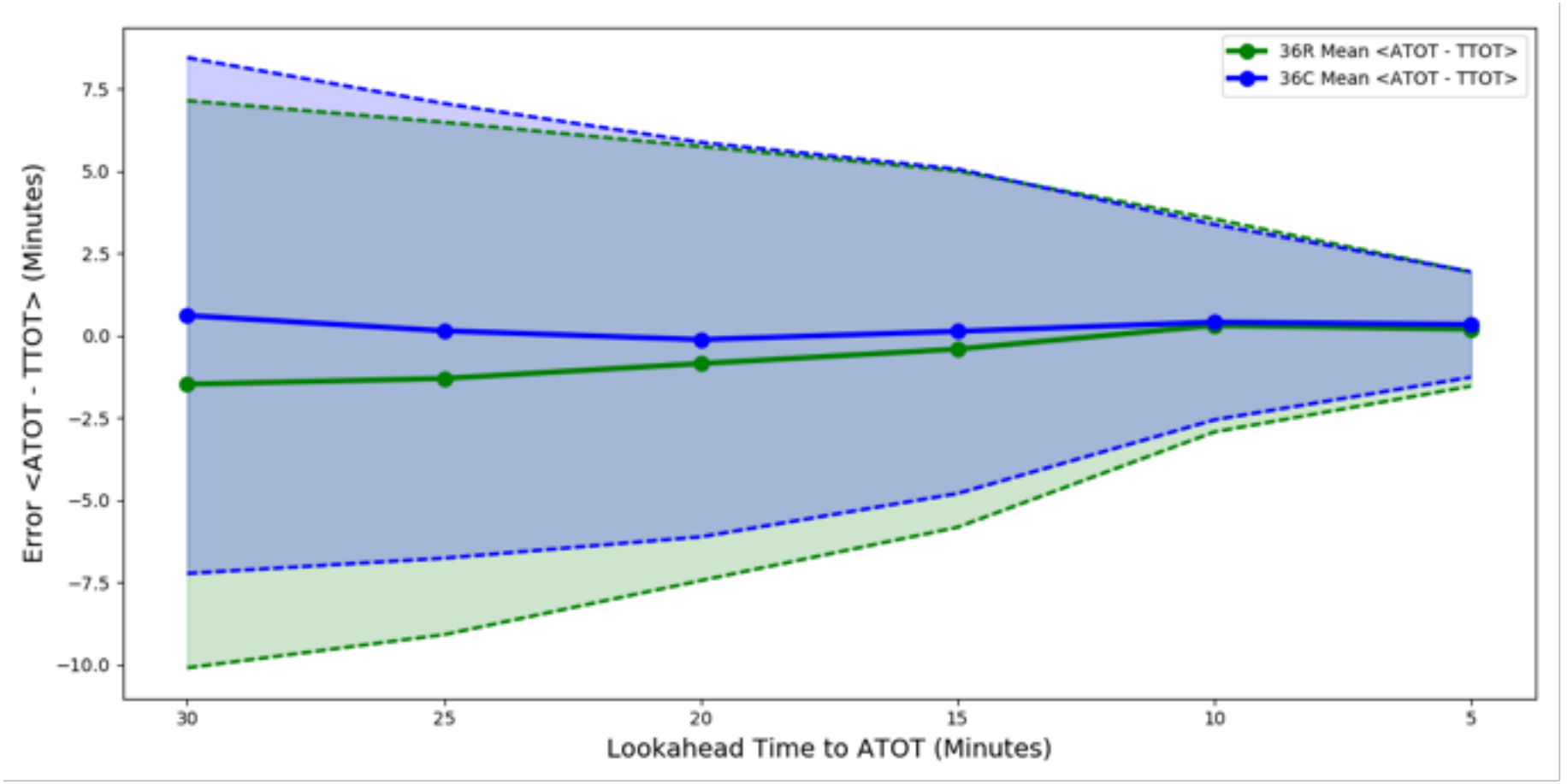
Accuracy of TTOT Predictions



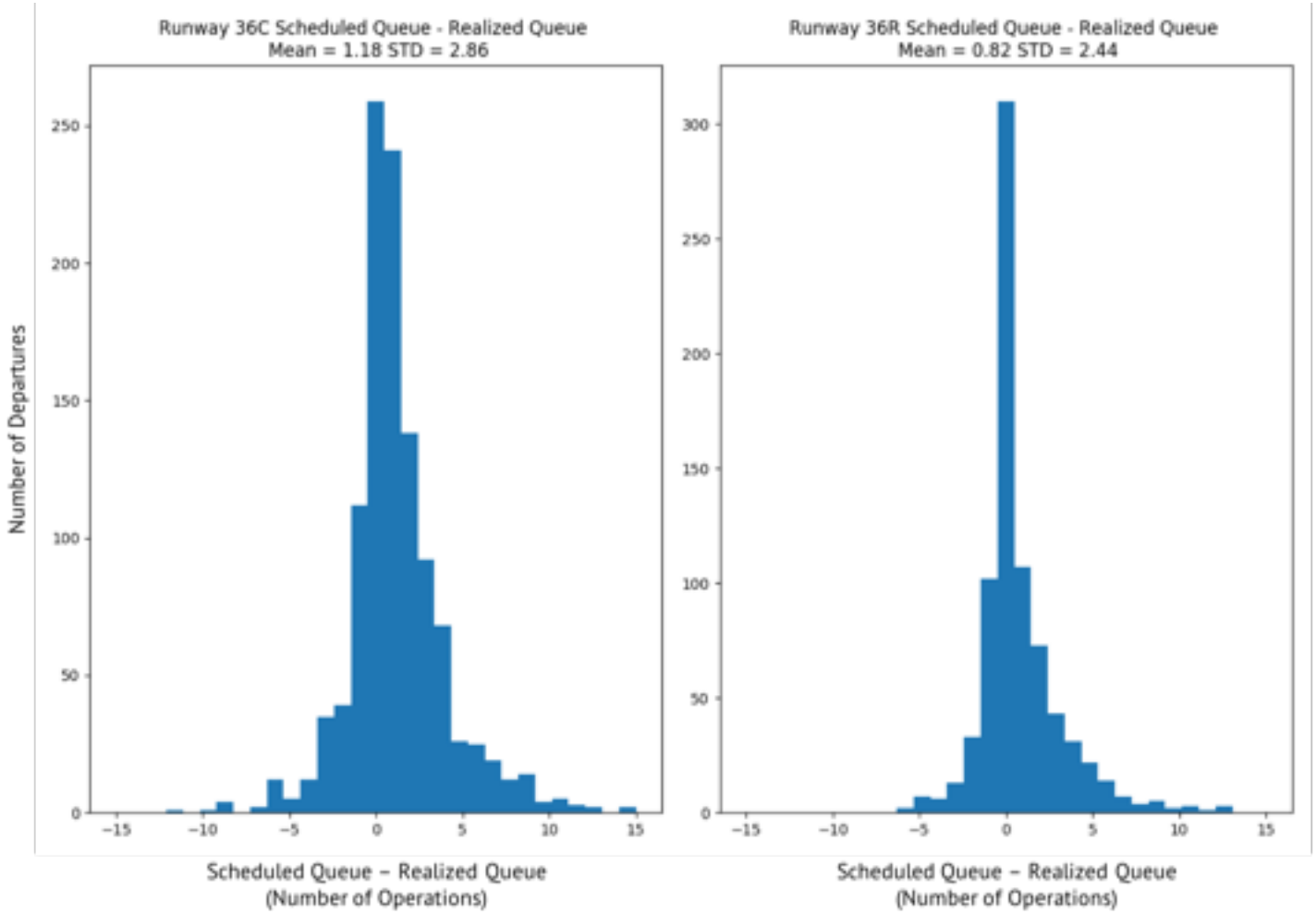
Accuracy of the TTOT prediction compared to the Actual Takeoff Time (ATOT) improves as the lookahead time decreases

Accuracy of TTOT Predictions



The average <ATOT – TTOT> contains less bias than we would expect after observing the bias in the runway rate

Relationship Between Runway Rate and TTOT Prediction Accuracy



The bias in the runway rate does not show up in the average <ATOT – TTOT> because not all aircraft scheduled to take off in front of a given aircraft materialize

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Challenges

- Uncertainty in the underlying trajectory prediction
  - Earliest Off Block Time (EOBT)
  - Pushback and engine spool duration
  - Taxi route / taxi speed
  - Controller actions (runway switch / unexpected hold)

- Uncertainty in runway operations
  - Runway crossings on 36C
  - Missed departure slots on the dual use runway 36R

- Accurate TTOT predictions requires both
  - Accurate prediction of the rate operations are using the runway
  - Accurate prediction of the departure sequence

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Conclusions

- We observed that the minimum-time wake vortex separation constraints resulted in scheduling departure operations at a slightly higher rate than the runway was operating
- We believe that for 36C this is due to runway crossings and for runway 36R this is a result of missed departure slots
- We were unable to recover this bias of over scheduling when we measured the average <ATOT – TTOT>
- We discovered that the bias did not materialize in <ATOT – TTOT> because not all aircraft scheduled to take off in front of a given aircraft materialize due to uncertainty on the surface
- Future work will investigate new techniques to reduce inaccuracies in the scheduled runway rate and scheduled queue sequence