Abstract
Continuous descents at low engine power are desired to reduce fuel consumption, emissions and noise during arrival operations. The challenge is to allow airplanes to fly these types of efficient descents without interruption during busy traffic conditions. During busy conditions today, airplanes are commonly forced to fly inefficient, step-down descents as air-traffic controllers work to ensure separation and maximize throughput. NASA— in collaboration with government and industry partners— is developing new automation to help controllers accommodate continuous descents in the presence of complex traffic and airspace constraints. This automation relies on accurate trajectory predictions to compute strategic maneuver advisories. The talk will describe the concept behind this new automation and provide an overview of the simulations and flight testing used to develop and refine its underlying technology.
Automation for Accommodating Fuel-Efficient Descents in Constrained Airspace

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Example of Problem:
Vertical Flight Profiles

Boeing 777 arrivals into San Francisco (SFO) over a two-week period
Example of Problem:
Lateral Flight Profiles

Distance (nmi)

SFO
Towards a Solution: Efficient Descent Advisor

Trajectory-based, strategic arrival clearances:

- Allow a gliding, continuous descent at low engine power
- Maximize arrival throughput
- Avoid traffic conflicts
- Can be issued by voice or datalink
- Integrate with existing avionics for precision guidance and control
EDA Development

Human-in-the Loop Simulation

Flight Testing

Continental Airlines

Boeing

United
Simulation Results
Comparison of Vertical Trajectories

Without EDA

With EDA
Using EDA for "Tailored Arrivals"
# Potential Benefits

Fuel and Emissions Reduction from Tailored Arrivals

<table>
<thead>
<tr>
<th>Traffic Conditions</th>
<th>Fuel Savings (lbs)</th>
<th>CO₂ Savings (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>227</td>
<td>715</td>
</tr>
<tr>
<td>Med</td>
<td>358</td>
<td>1,128</td>
</tr>
<tr>
<td>Heavy</td>
<td>1,760</td>
<td>5,544</td>
</tr>
</tbody>
</table>

For Boeing 777 Operations into San Francisco
Potential Benefits
Noise Reduction from Tailored Arrivals

Before

After
Summary

• Potential environmental benefits of low-power descents are greatest during busy traffic conditions

• Trajectory-based automation and procedures are key to realizing these benefits

• NASA is working closely with FAA and industry to develop the required technology