Continuous Descent: Saving Fuel and Reducing Noise for Airliners

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Hartsfield-Jackson Atlanta International Airport is the nation’s busiest.

(PhysOrg.com) -- Airline passengers arriving in Atlanta on early morning “redeye” flights during the past few months may have noticed something different during their descent to the runway. Instead of the typical sound of engine power rising and falling as the aircraft descended in a series of level flight steps, they may have noticed a quieter arrival - without the steps.

The changes were part of Georgia Tech’s flight-testing of “continuous descent arrivals,” a procedure designed to save fuel and time while producing environmental benefits by reducing both noise and emissions. Involving more than 600 flights, the Atlanta study was done in collaboration with the Federal Aviation Administration (FAA), FedEx and Atlanta’s two dominant air carriers: Delta Air Lines and AirTran Airways.

The continuous descent arrival procedure has already been studied at Louisville and Los Angeles airports. Proponents hope the 90-day test at Hartsfield-Jackson Atlanta International Airport - currently the nation’s busiest airport - will move the concept one step closer to nationwide implementation. Estimates suggest that continuous descent arrivals could save a large airline as much as $80 million per year in fuel costs alone.

“In commercial aircraft, we see anywhere between 300 and 1,000 pounds of fuel saved for each arrival,” said John-Paul Clarke, director of the Air Transportation Laboratory at Georgia Tech and an associate professor in the School of Aerospace Engineering. “With fuel cost at $3 per gallon, that would amount to as much as $600 per arrival and could really add up for the airlines at a time when they need all the savings they can get.”

Because aircraft engines don’t throttle up and down during a continuous descent arrival, there are also significant reductions in noise and emissions. Keeping engines at idle power can cut emissions of nitrogen oxides by nearly a third, and reduce noise by 6 decibels along certain portions of the flight path - both significant reductions that would improve the environment in the vicinity of airports.

And the technique could cut two minutes off the approach and landing portion of a flight. While that doesn’t seem like much, it could result in more efficient utilization of aircraft and reductions in flight times for crews.

Continuous descent arrival is one in a series of improvements aimed at creating the next generation of air transportation technologies. The goal is to redesign the airspace to allow future airliners to travel the most efficient paths to their destinations.

Though the final numbers from the Atlanta evaluation won’t be known for several months, the potential savings have been demonstrated by more than 60,000 landings at Los Angeles with a continuous descent arrival technique developed by

Georgia Tech. But adopting the procedure throughout the airspace system won't be easy. Safety considerations must be paramount, and there are a number of optimization challenges caused by widely varying aircraft types, wind conditions and airport configurations.

"Imagine a line of aircraft descending through a long tube that's fixed laterally and limited vertically to be within a narrow band," explained Clarke. "If each airplane were like a ball with a different coefficient of friction, then when you put the balls in the tube at equal intervals, they would begin to catch up with one another. The ball with the lower coefficient would tend to catch up with the ball with a higher coefficient. That's something that we have to work very hard to avoid."

While the risks of getting aircraft too close are obvious - and governed by FAA rules on minimum spacing - too much spacing between landing aircraft can waste time and reduce airport throughput.

"The goal is to design a procedure that allows the aircraft engines to throttle back to idle power at the point of initial descent and to remain at idle power along the flight path to the runway as long as possible," Clarke added. "We have figured out how to put altitude and speed constraints along the flight path so they can stay at idle power as long as possible while achieving the required minimal spacing at the runway threshold."

Determining those constraints requires detailed knowledge of the performance of each aircraft type in use. Clarke and his research team have obtained performance data for most Boeing aircraft, as well as some of those manufactured by Airbus. Based on the performance data, they have simulated the operation of each aircraft type under varying wind and weight conditions.

The researchers have also modeled variation in pilot behavior, because small differences in when flaps are deployed and landing gear lowered create variations in speed, which affect aircraft spacing.

Arrivals would be customized for each airport, taking into account wind and traffic patterns. And because the spacing between aircraft is determined well before they arrive at their destinations, adoption of the technique will require changes in the nation's air traffic control system.

"The air traffic control system currently isn't designed to allow the kind of fine-tuning we need, but I'm very optimistic about being able to change that," said Clarke. "Throughout all the areas, the FAA and the airlines, there is a growing acceptance that this is a solution. We have been able to do the analysis, the flight-testing and the number crunching to show that it can be done."

Clarke, who began the research at the Massachusetts Institute of Technology before joining Georgia Tech in 2005, believes the cost savings will ensure adoption of continuous descent arrivals. He compared the technique to the adoption of fuel-saving winglets, small vertical attachments that have replaced traditional wingtips on many aircraft.

"For years people knew that winglets provided better performance, but it costs money to install them," he added. "When fuel got more expensive, airlines started installing winglets because the savings justified the costs. The benefits of continuous descent arrival may also take some time to be realized."

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