

In Brief

Scientists from the Universities of Stirling and Nottingham in the United Kingdom tackled the knotty problem of delays on airport taxiways, where planes are entering or leaving runways. Sandy Brownlee, PhD, and Jason Atkin, PhD, collaborated with Manchester Airport to use cloud computing to model the complex data from many airports worldwide. The team created open-source tools using Linux on Microsoft Azure to expand these insights and create new algorithms, sharing these on Github. The team is helping Manchester Airport to reduce delays, save money and lessen any environmental impact.

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Websites for reference

www.azure4research.com

Linux and open-source computing on Microsoft Azure <http://aka.ms/azurelinux>

Ground movement tools on Github <https://github.com/gm-tools/gm-tools/wiki>

Automated Scheduling, optimisAtion and Planning (ASAP) Group <http://www.asap.cs.nott.ac.uk/>

Manchester Airport Transformation Program <http://mantp.co.uk/>

Streamlining airports with cloud computing



Tim Walmsley helps the third-largest airport in the United Kingdom — Manchester — manage an estimated 23 million passengers per year. To successfully plan airport operations and growth, he asked for data science help from university researchers, who specifically sought to gain insights from modeling the movements on taxiways, to and from the runways.

“Aviation is an industry that’s growing. So there are lots of ways that the industry is trying to tackle the impacts that that growth could bring. The Airport Optimization Project feeds into that,” Walmsley, Environment Manager for Manchester, explained.

Sandy Brownlee, a senior research assistant at the University of Stirling, began helping Manchester Airport by searching for specific data on what is sometimes called “ground movement” or taxiing to populate a model. At first, he was frustrated because individual airports did not want to share everything with him. What he discovered, however, is that he could access public data using Flight Radar 24 and Open Street Map for dozens of airports worldwide. Jason Atkin, PhD, of the University of Nottingham, partnered with Brownlee to help model how taxiways can be leveraged to make airports more efficient.


TAXIWAYS CONNECT EVERYTHING

The time aircraft spend getting to and from runways is one of the understudied choke points at airports. “Taxiing is a really critical problem because it connects everything else,” Brownlee explained. Many are familiar with strategies for aligning takeoffs or landings to improve safety or efficiency but that slow crawl toward the gate (called a stand in the UK) can be a crucial link in the chain of events.

“The computing power we’ve got now allows us to understand and analyze data in different ways and pull out different information so we can better understand the true uncertainty in taxiing. We can understand which aircraft take a long time to get there, which aircraft get there quickly, and under what circumstances this is happening,” Atkin said.

“Taxiing is a really critical problem because it connects everything else”

Sandy Brownlee *Senior Research Assistant, University of Stirling*



“By getting better predictions, you can start improving the rest of the airport system”

Jason Atkin Assistant Professor
University of Nottingham

PUBLIC DATA SOURCES

Using Microsoft Azure, Brownlee could use Linux virtual machines and develop methods using OpenJDK. By leveraging these open source tools on Azure he completed his work in about one-tenth the time he might if he'd used just his desktop computer. “So rather than spending several months waiting for my data to be ready so that I could get on and do things, I had it within a couple of weeks,” he said.

There were three main tools that the team created to share on Github. TaxiGen reads taxiway and runway information from Open Street Map and then automatically writes it out in a usable format. SnapTracks reads raw GPS coordinates with timings and adds them to TaxiGen material. GM2KML generates helpful visualizations from the other two tools.

“Researchers rely on open tools and platforms to be able to develop and share their work. The ability to use the cloud for access to computing power not available on the desktop can act like a time machine, shrinking the time to results from months to weeks. This is a transformational way of thinking about research computing,” explained Kenji Takeda from Microsoft Research, who was supporting the project. Brownlee’s work on analysis of ground movement was funded by the Sandpit for Integrating and Automating Airport Operations and DAASE grants from the Engineering and Physical Sciences Research Council (EPSRC).

One pilot can take longer than another to cover the same ground, traffic congestion can be heavy at busy times, and mechanical delays of any sort can throw off predictions. Taxiing delays ripple through the entire system. Modeling and predicting that taxi time helps airports change when and where they direct planes and can yield big savings. Brownlee estimates modeling could help cut bottlenecks at Manchester in half.

OPEN SOURCE BENEFITS

Because the tools created by the team are available to anyone, both Brownlee and Atkin foresee that other airports around the world will use them. “The work that Sandy’s doing is going to provide a lot of public domain data and the ability to analyze this for a lot of different airports. And we should be able to see these multi-million-pound savings at airports worldwide,” Atkin said.

Brownlee also hopes models will help guide decisions in weather emergencies or when a runway must be closed. Airports worldwide can use the modeling to understand what to do about a sudden change. “By getting more researchers worldwide involved ... we could get a lot more benefit from different areas of knowledge all coming from the same problem,” he said.

No matter what the world does with the open-source tools, for Walmsley the great impact is at Manchester, where he expects “a much better experience for the customer and for the airlines using the airport.”