CHARACTERIZATION OF DELAY PROPAGATION IN THE AIRPORT NETWORK

P Fleurquin*, J J. Ramasco, V M. Eguíluz, M. San Miguel
IFISC Instituto de Física Interdisciplinaria y Sistemas Complejos (CSIC-UIB), CSIC-Universidad de las Islas Baleares 07122-Palma (Mallorca)

Complex networks[1,2] provide a suitable framework to model air traffic. Previous works[3–5] described the world air-traffic network as a graph with direct flights between airports as edges and passenger commercial airports as vertices.

In this work we characterize the US airport network, in the time period 2005-2011, as a weighted graph where the accumulated delay in each airport and the average delay per flight is, respectively, the node and edge strength. We observe that the dynamical behaviour of clusters[6–8], representing groups of delayed connected airports, is very volatile; in particular, the largest cluster has an explosive growth. Motivated by this empirical result, we propose a queuing model based on delay propagation between single company flights and airport congestion due to over-scheduling, which reproduces the empirical observations. Furthermore, we analyze the implementation of different operations protocol and the impact over the flight schedules.

This investigation is expected to help devise more efficient strategies for delay management, both from the point of view of ATM (e.g., flight prioritization criteria) and of airline planning (e.g., robust scheduling).

---

* pfleurquin@ifisc.uib-csic.es

[1] DJ Watts, SH Strogatz, Nature 393, 440 (1998)
[2] AL Barabasi, R Albert, Science 286, 509 (1999)
[3] A Barrat, R Pastor-Satorras, A Vespignani,Proc. Natl. Acad. Sci. USA 101, 3747 (2004)
[4] R Guimera, S Mossa, M Sales-Pardo, LAN Amaral,Proc.Natl. Acad. Sci. USA 102, 7794 (2005)
[5] M Sales-Pardo, R Guimera, AA Moreira, LAN Amaral,Proc. Natl. Acad. Sci. USA 104, 15224 (2007)
[6] J Hopcroft, O Khan, B Kulis, B Selman, PNAS 101, 5249 (2004)
[7] G Palla, A Barabasi, T Vicsek, Nature 446, 664 (2007)
[8] S. Asur, S. Parthasarathy, D. Ucar,TKDD 3, 913 (2009)