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Apron Operations Micro-Simulation Model for Hong Kong International Airport

Hong Kong International Airport is one of the largest airports worldwide – and it will become even bigger. PTV's micro-simulation software VISSIM allows airport planners to simulate all stages of passenger and vehicle movement within the airport boundary. In a pioneering project PTV Asia-Pacific, in partnership with the Hong Kong Airport Authority, has developed a micro-simulation model of the apron road network, taxiways, runways and gate operations.

Hong Kong International Airport (HKIA) is the fifth busiest international passenger airport, with more than 47 million passengers in 2007, and operates the busiest international cargo facilities in the world. With some 800 aircraft movements every day and about 90 airlines operating from HKIA, the airport links Hong Kong with over 155 destinations around the world.

Newly completed airfield improvements include the construction of the North Satellite Concourse, the addition of new taxiways and resurfacing of the two runways. Within a few years, additional hangars for aircraft maintenance and business jets will come into service. Planning for the future, HKIA has been preparing plans for the undeveloped area in the 'Midfield' between the two runways that will be developed in phases to meet future demand. HKIA will also soon commence the engineering and environmental studies on the feasibility of a third runway at the airport and a new cargo terminal will open in 2011.

The Airport Authority (AA) wishes to develop options for parking stand layout, taxiway configuration, passenger terminal location and layout, and associated passenger facilitation systems. Recent studies have identified improvements to increase the capacity of the existing dual runways from 55 movements per hour at present up to 68 movements per hour in 2015. A current study will assess the incremental air traffic movements associated with a possible third runway.

Successful planning with VISSIM

Traditionally, the design of improvement and expansion projects for airports has used a variety of specialist design and planning software tools for different elements of the airport operation, but there has been a lack of a comprehensive micro-simulation tool that is able to replicate apron operations in real-

time, including all of the ground service operations associated with the arrival or departure of an aircraft, along with land-side transport operations, and passenger movements within the terminal.

PTV's micro-simulation software VISSIM is the only software package capable of simulating all stages of passenger and vehicle movement within the airport boundary. VISSIM has recently been used in the planning and design of land-side facilities for many airports including London Heathrow T5, Bangkok, and Auckland.

The new passenger simulation capability in VISSIM 5.1 is now being applied in pilot projects for Hong Kong Airport Northern Satellite Concourse and other key transport infrastructure. In a pioneering project PTV, in partnership with the Hong Kong Airport Authority, has developed a VISSIM micro-simulation model of the apron road network, taxiways, runways and gate operations. The model can import any daily timetable and can simulate any specified time period, including 3D visualisation of all aircraft and vehicle movements on the apron, in faster than real time, including movements of the following vehicle types:

- ▷ Marshaller's car
- ▷ Catering truck
- ▷ Waste water removal tanker
- ▷ Passenger bus (remote gates)
- ▷ Refuelling pump
- ▷ Maintenance vehicle
- ▷ Aircraft towing tug
- ▷ Cleaners crew bus
- ▷ Baggage tractor and trailer
- ▷ Potable water delivery truck
- ▷ Individual passengers/crew
- ▷ Cargo loader and conveyor

All aircraft movements are assigned on static routes consistent with apron control procedures and guidelines, while all ground service vehicles (GSE) are assigned to the apron road network dynamically, each searching for the fastest route, based on parameters and constraints defined for each vehicle type.

The potential applications of this model are wide and varied, and apart from being used for evaluation of the efficiency of design alternatives, can answer the following (and similar) questions:

- ▷ Where are the key bottlenecks on the apron road network and how can they be improved?
- ▷ How long does the baggage take to travel from each gate to the baggage hall, and how variable is the travel time?
- ▷ Where is the best location on the apron to park critical GSE?
- ▷ How many vehicles of each GSE type do we need to service a given flight timetable in normal operations?
- ▷ What are the impacts of abnormal operations, such as runway closure, blockage of a key element of the apron, or disruption due to adverse weather or an unusual incident or event?

Background Report



- ▷ How do we re-establish normal operations after an interruption, and how long will it take to recover normal service?
- ▷ How do we optimise our GSE acquisition and utilisation plans?
- ▷ How can we manage maintenance impacts and when can we close a part of the apron without significant impact?
- ▷ How can we check planned management strategies, without risking adverse impacts, during maintenance or construction activities?
- ▷ What can we do to maximise utilisation of key facilities and equipment and what is the financial benefit?

The VISSIM model is approaching completion, with the calibration of background traffic volumes presently underway, and will shortly commence scenario testing. Hong Kong Airport is one of the busiest and most complex airports in the world and the models have been developed in a modular manner, using a series of inter-linked simple scripts, so that they can be applied to other smaller airports with little adaptation effort. In the longer term, it is planned that many of the procedures developed during this exciting cutting-edge project will be built into the core of VISSIM and a dedicated graphical user interface will be implemented for use by airport planners and designers.

Background Report

Images



VISSIM used for modelling apron operations at Hong Kong International airport



Airports such as London Heathrow T5, Bangkok and Auckland, also chose VISSIM for the planning and design of land-side facilities.

More information:

- ▶ More about VISSIM: <http://www.ptvag.com/traffic/software-und-system-solutions/vissim/>