Checkpoint 2 Update – Current State of the project

Division of Labor

The division of labor is assigned such that all members of the team will have a focus, while being able to contribute to the overall project integration equally. The simulation workload is divided into passenger flow system, airport traffic system and system integration. Mugundhan and Xiaoliang will focus on the construction of passenger flow system, while Saran and Hui will dedicate their effort on airport traffic system. All four members of the team will work together to integrate the above two system with a queuing system simulation.

Simulation Progress

Passenger flow:

- Check-in and immigration/security queue – passenger_model.py
    1. Current Status: To simulate the passenger flow model, simpy package was used to formulate a class for passenger arrival schedule and the subsequent queuing systems scheduled after the passenger arrival. The passenger arrival schedule is uniformly distributed initially for the purpose of formulating the model. The passenger flow model is triggered by the arrival process which in turn schedules the subsequent processes like Check-in, Immigration and Security.
    2. Assumptions: The initial constants for checkin, immigration and secutiry process like time to walk to the counter, number of queues (capacity), time taken to process a passenger at the respective counters, are all assumed as required ie., constants or distributions with mean and standard deviation. The passenger is assumed to take the shortest queue at each process.
    3. Next steps: The next step would be to integrate the passenger flow model with the gate queue and boarding process. After that, we plan to formulate a way to combine passenger flow model with the airport flow. Finally, we will implement visualization techniques and analyzing the results by choosing appropriate parameters for our model.
- Gate queue and boarding process – TerminalGate.py
    1. Current status: TerminalGate was initially coded as a separate class in an event-oriented simulation environment. It was assumed that a passenger's arrival triggers the queue function that adds to the queue for boarding. The boarding queue will be reduced based on the boarding status i.e. whether the plane is ready for boarding. The is_boarding flag is determined by whether the plane has reached scheduled time for departure, and whether the boarding queue has been cleared for a given amount of threshold time period.
    2. Assumptions: In this initial phase of development, the boarding queue is assumed to be purely a function of whether passengers have moved out of the checkin, immigration and security. This assumes that all passengers will be at the gate immediately following the previous processes, and the time difference between security and the gate is constant. This is an implicit assumption since gates have different distance to the security point in reality, which will contribute to time difference from the security point to the gate.
    3. Next steps: A major next step would be to modify the TerminalGate class based on the process-oriented simulation flow. This is necessary as an important integration step with the other portion of passenger flow simulation. It has been decided within the group that the process-oriented simulation will best suit the simulation environment of simpy package and makes most sense when a congestion analysis of each passenger/airplane is of interest.

Airport flow:

- Airplane arrival and Departure and Runway Usage – Airport_traffic_flow_sim_updated.ipynb
    1. Current status: The simulator can be represented by four classes and one simulator, namely runway, airplane, department table, landing table class, and air traffic flow (ATF) simulator. The departure table and the landing table are used to schedule the take-off and landing events of the plane respectively. As a resource in simpy, the runway will be occupied by the take-off and landing events of the aircraft. The entire simulation process can be described as the following process: ATF simulator will first initialize the number of resources for the runway, and then use the department table and landing table to reserve take-off and landing events. According to the event scheduled time, the runway will handle the take-off and landing events of the aircraft. However, when the passenger capacity of the aircraft is less than 90%, the aircraft cannot enter the queue for takeoff but is marked as late status, and then the takeoff event is triggered according to the boarding event of the aircraft.
    2. Assumptions: Assumptions include uniformly distributed schedules for departure and arrival (a constant time interval and random offset is used to schedule both arrival and departure). Time to land and time to take-off is assumed to be constant. Time on the ground for every aircraft is considered constant and is not affected by any delays in boarding or other processes at the terminal. In the current phase, it is assumed that every aircraft takes off without any delay. Conditions for landing and take-off are considered excellent and constant during the entire ATF simulation process. First In First Out (FIFO) system is employed as part of the simulation queue to schedule the arrival and departure.
    3. Next steps: The Airport Flow model will be integrated with the Passenger Flow model in the next phase. As part of the integration, delays in departure and arrival of the aircraft will be simulated. Delays will be scheduled based on the boarding status of the aircraft, which will be known from the passenger flow model.