Flight Simulation (List 4)

Due: 23.11.2016

The boeing 737 is the most sold jet airliner in the history of aviation. Approximately 8000 have been sold, and 4000 have been ordered.

1. First we are interested in what the pilots and the passengers see. Consider a passenger sitting in seat 23A (window seat on the left, behind the wing), the pilot, and a passenger in seat 7F. (Window seat on the right, in front of the wing)

   Give the positions (in airplane body coordinates) of these bogaterów, and give the quaternions that transform from airplane coordinates into their eye (camera) coordinates.

2. (a) Using the drawing, estimate the aspect ratio of the wing.
   (b) Estimate the surface area of the wing.
   (c) The maximum take off weight of a B737 is 63 000 kg. Assuming that take off takes place at 150 knots, and the wing area is as in the drawing, compute C_L during take off.
   (d) Maximum landing weight is 52 000kg. Assuming that landing takes place at 130 knots, (this estimate is a bit low), what is C_L during landing?

3. (a) Assuming that each engine is able to produce 89 kN of thrust, how much runway is needed to reach 150 knots, assuming the take off weight is 63 000 kg? You may ignore drag during take off acceleration.
   (b) Assume that during take off, the right engine fails, and only the left engine works, still at maximum power. What is the torque in this situation?
   (c) Estimate the surface area of the rudder.
   (d) In case of engine failure, the pilot has two choices: Either abort, or continue the take off. In case the take off is continued, the rudder has to be used to keep the plane straight. Assuming that $C_L = 1.2$, for the rudder, and C_M around 0.25 of chord length equals 0, estimate the minimal speed from which the take off can be continued with one engine failure.

(e) Compute the length of the runway that is needed, when engine failure occurs at the moment that you calculated in task 3d.

4. The B737 seems to be able to fly 4200 km with 130 passengers, using 16 000 liters of fuel. Compute the fuel used per passenger per kilometer, and compare this to fuel use of typical car.