ILS Glide Slope Math Modeling Study
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Watts Antenna Company requested a modeling study of the effects from a A-380 on several types of image glide slope at a generic airport.

A modified version of the Ohio University IPPM version 2.05 was used for modelling. The model uses strict physical optics to compute scattering effects from flat rectangular structures over a flat, level ground plane. The only modifications made were to the source code to include Watts Antenna Company antenna descriptions. The scattering algorithms were not altered.

A plate model of a representative A-380 aircraft was generated, based on information obtained from the Internet. A diagram of the aircraft is shown in Figure 1. Strict physical optics means that only the illuminated side of each plate scatters, but the plate model was made with a "left" and "right" side so scattering could occur from either side.

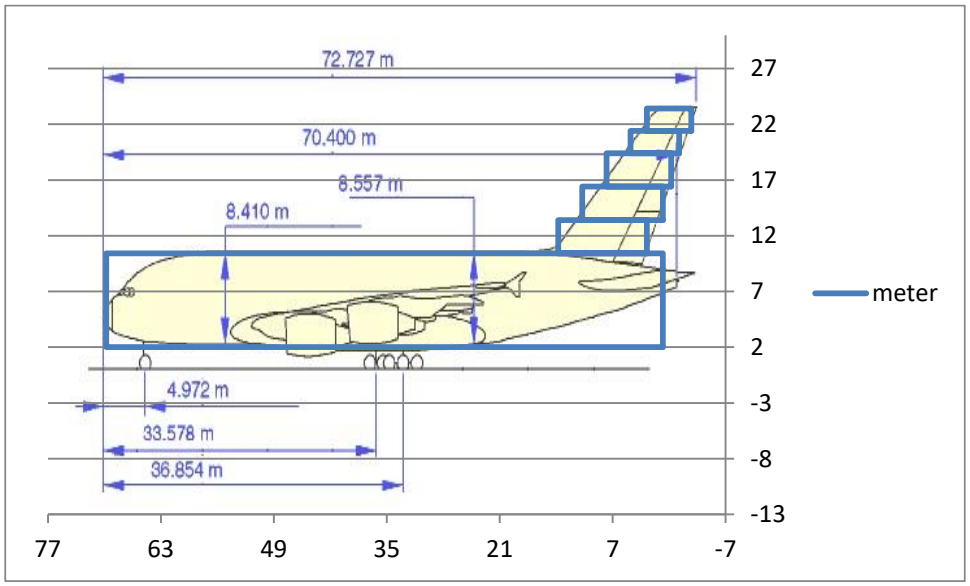


Figure 1. Plate Model Description of Scattering Aircraft

Scattering geometries were consistent with the convention described in *ILS Critical and Sensitive Areas: ICAO NSP and Eurocontrol Developments*[1]. The coordinate identifying the aircraft was toward the back, as indicated in Figure 1. The dimensions in Figure 1 indicate displacement from the model coordinate in the Y and Z directions, where X is the lateral offset from centerline, Y is the distance from extended runway threshold, and Z is up.

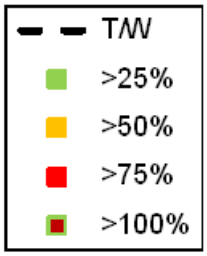
Aircraft placement was every 50 meters in X between -50 and +350 meters, and every 25 meters in X between -25 and +250 meters.

The glide slope was fixed at X = -300, Y = +122 meters. A null reference and capture effect glide slope were modeled at this location with antenna height designed to produce a three degree approach.

A three-degree approach was simulated from 4 nmi to threshold. Cockpit CDI was calculated, and compared with Category III tolerances. All data was processed using a low pass filter with a time constant of 0.422 seconds. This is representative of the inertia of a cockpit CDI needle. This filter has been used for decades, and is built-in to the model.

The colored dots represent a percentage where a threshold tolerance was exceeded for an aircraft at this location. The coordinate corresponds to a point at the back of the aircraft. All aircraft were modeled parallel to the runway.

The color scheme is outlined in the table below. For example, a white space indicates maximum approach tolerances that are less than 25% of Category III. A green dot indicates a Category III tolerance between 25 and 50% was found somewhere along the modeled approach at that coordinate, and so on.



[1] Gerhard E. Berz , et al, “ILS Critical and Sensitive Areas: ICAO NSP and Eurocontrol Developments”, 19th International Flight Inspection Symposium (IFIS)
Belgrade, Serbia, 13-17 June 2016.