

# Traffic Densities From LA2020 Traffic Scenario – Filtering Using Closing Velocity

**Draft – ASSAP WG**

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# Purpose

- **Response to Action Item #3**

AI#3

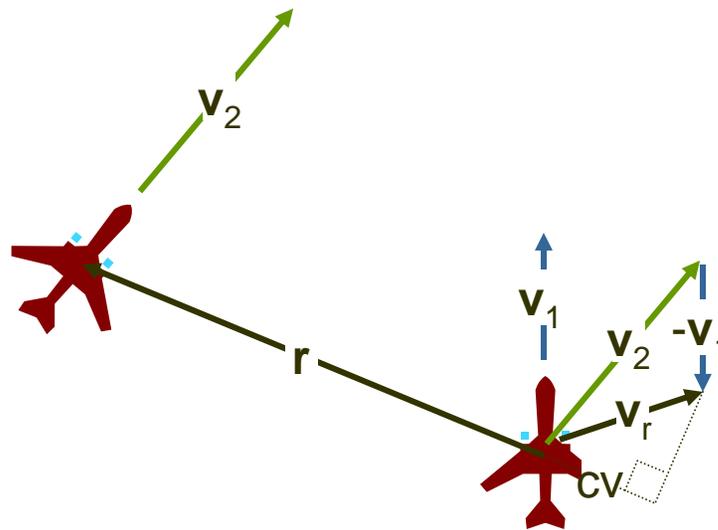
Develop/discuss filtering constraints (e.g., number, range, altitude, vertical height) as relate to the LA Basin 2020 scenario and projected traffic densities.

Note: Neither Mike Castle (APL) or Larry Bachman (APL) were in attendance. The individuals were volunteered without their knowledge or consent. Determine the traffic count applying various filters to the 234 targets to eliminate targets moving away, etc.

# Filtering by Closing Velocity

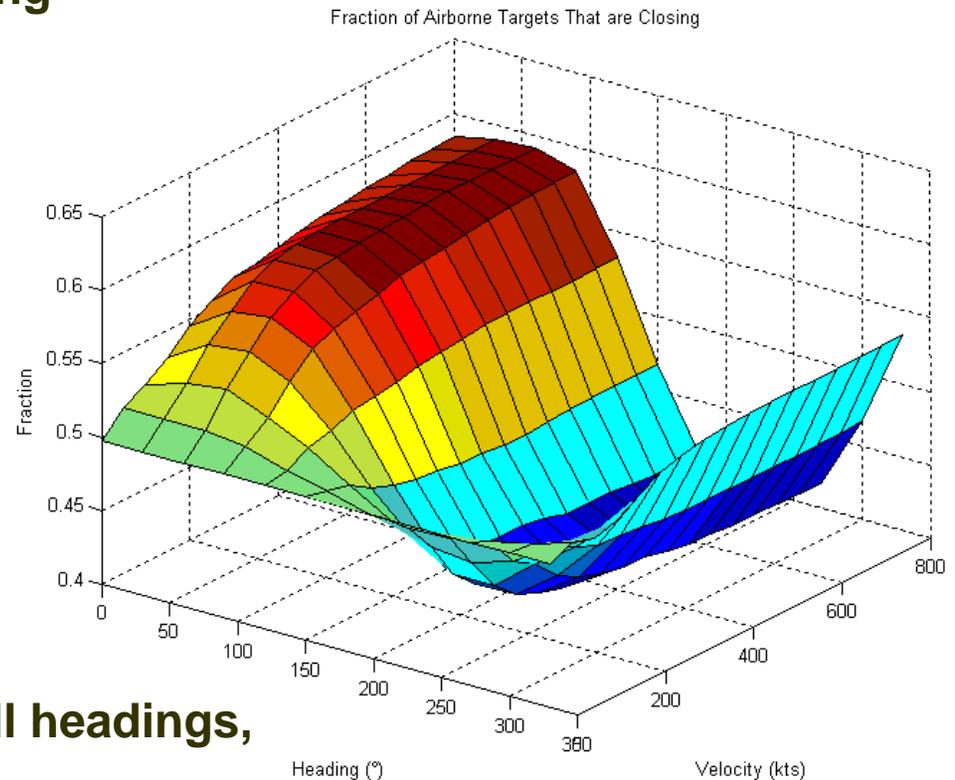
- Closing velocity (cv) – the component of the relative velocity vector parallel to the relative position of two targets.

$$cv = (\mathbf{v}_2 - \mathbf{v}_1) \cdot \mathbf{r} / |\mathbf{r}|$$



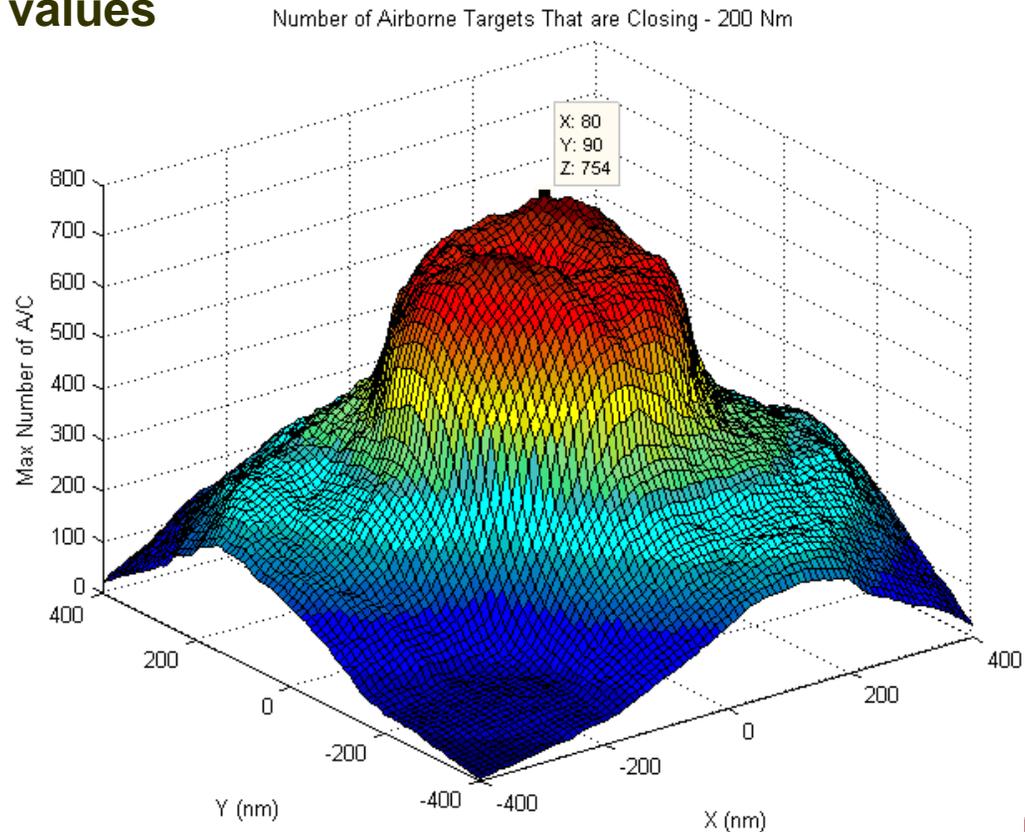
# Reduction in Targets Vs Heading

- Targets are filtered out if closing velocity is  $< 0$
- Fraction is the portion of targets that remain after filtering
- Results depend on ownship heading - depending on whether or not ac is moving towards dense area
- When ownship speed = 0, half of ac are filtered
- Effects of filtering increase with ownship speed
- Since results depend on ownship position, speed, and heading, we look at max number of ac for all headings, at different locations in airspace...



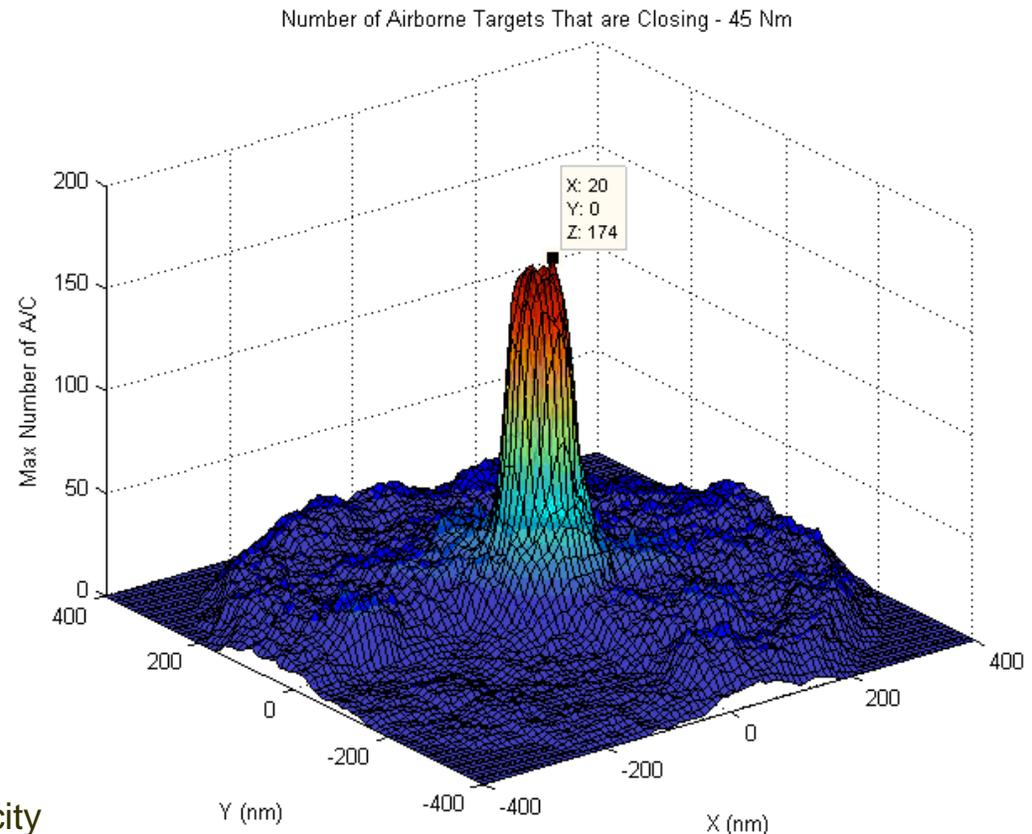
# Number of AC within 200 Nm of Ownship

- 200 nm is max range of typical receivers / transmitters
- X and Y are the ownship positions about the center of LA2020 scenario.
- The vertical axis represents the max number of closing aircraft, within 200 nm, for a range of heading values (0, 60, ... 300).
- Ownship speed = 600 kts
- Maximum = 754 aircraft



# Number of AC within 45 Nm of Ownship

- 45 nm is coverage volume specified in ASA MASPS for CD application
- 600 kts ownship speed
- W/o cs filtering = 234 aircraft<sup>1</sup>
- With cs filtering = 174 aircraft
- If targets < 5 NM range are included, max = 177 aircraft
- 26% reduction in targets
- If ownship speed = 150 kts, max = 154 aircraft



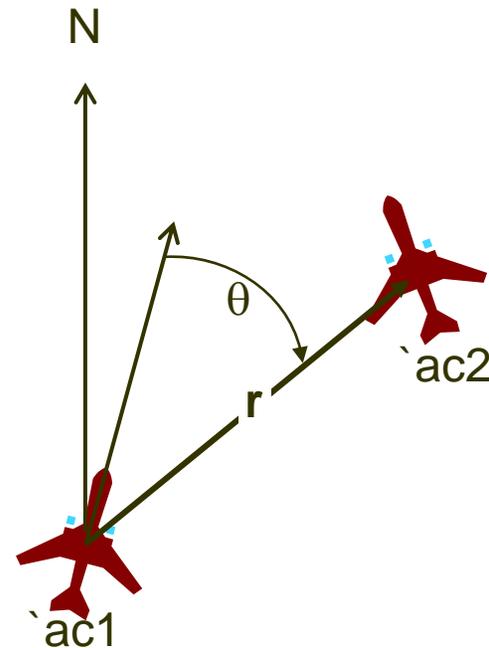
<sup>1</sup> "Determination of Minimum Tracking Capacity Requirements for ASA Applications" ASSAP-WP08-12

# Filtering by Range and Bearing

- Range to Conflict Detection Zone Alert

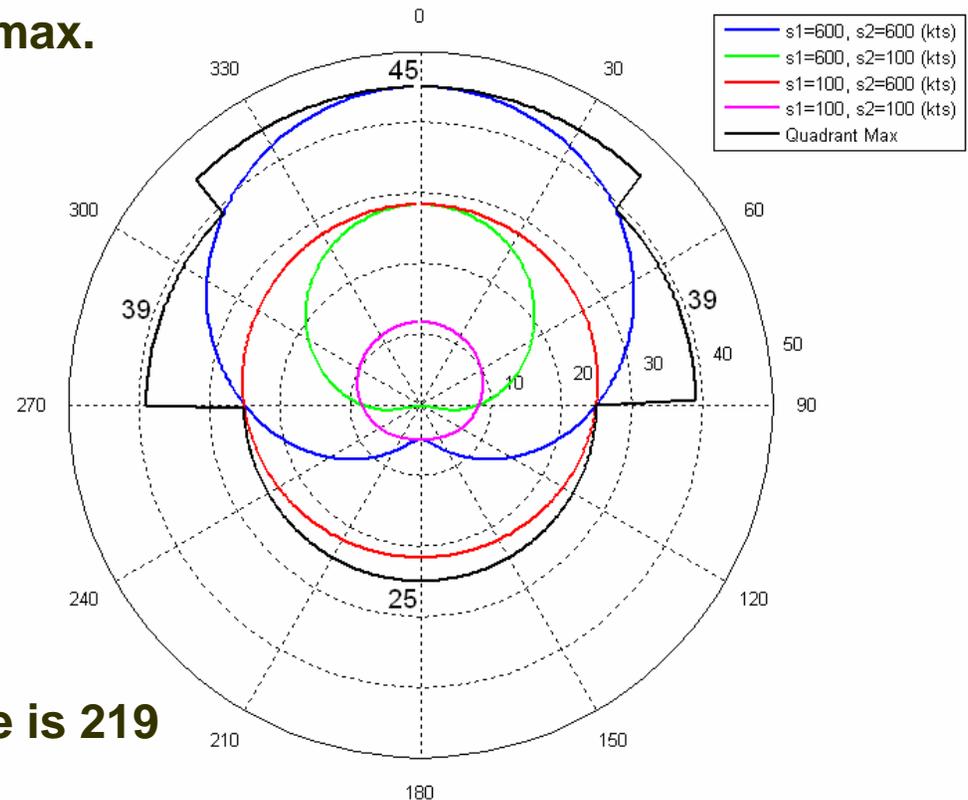
$$\text{range} = ( s_2 - s_1 ) \times 120 \text{ sec} + 5 \text{ NM}$$

where  $s_1$  = speed ac1,  $s_2$  = speed ac2,  
120 sec is the CDZ alert time,  
5 NM is the CDZ horizontal size.



# Filtering by Range and Bearing

- Several combinations of min. and max. expected speeds are applied
- The max. range within given bearing bounds is plotted in black
- The range values are:
  - 45 NM ( $315 \leq \theta < 45$ )
  - 39 NM ( $45 \leq \theta < 90$ )
  - 25 NM ( $90 \leq \theta < 270$ )
  - 39 NM ( $270 \leq \theta < 315$ )
- The max number of airborne aircraft given this coverage volume is 219
- If the closing velocity filter is also applied, the max number of airborne aircraft is 174 (the same as without the Range-Bearing filter)



# Conclusions

- Filtering out targets that are diverging horizontally results in a processing capacity of 174 aircraft
- Filtering out targets based on a coverage volume that is Range and Bearing dependent reduces the processing capacity to 219 aircraft
- The application of the Range-Bearing filter to the Closing Velocity filter does not further reduce the number of targets.