Cockpit Visibility and Traffic Information Service Study

Aircraft Performance presentation
Topics

• Cockpit visibility results
• Description of traffic information service (TIS)
• Sequence of time points depicting
  – Re-creation of views of helicopter from airplane
  – TIS information provided to both aircraft
Determining Cockpit Visibility

“Target” Aircraft

“Viewer” Aircraft

Line of sight

Elevation angle

Azimuth angle

x-y projection

x

y

z
Angles from Helicopter to Airplane

-140 -120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180

Elevation angle, degrees

Azimuth angle, degrees

Straight ahead
Angles from Helicopter to Airplane
Angles from Airplane to Helicopter

Area of interest

Elevation angle, degrees

Azimuth angle, degrees

1152:28
1153:09
1153:14
Traffic Information Service (TIS)

- Radar-based system
- Intended as aid for spotting traffic visually (not collision avoidance system)
- Existing guidance discourages pilots from initiating evasive maneuvers based on TIS information only
- TIS information can be used to pre-empt need for future evasive maneuvers
TIS Service Volume and Alert Threshold

- TIS tracks up to eight intruder aircraft located within 7 nm horizontally and -3,000 to +3,500 ft vertically.

- Visual and aural alerts triggered when intruder estimated to intercept course within 0.5-nm radius and ± 500 ft within 34 seconds.
TIS Cockpit Display Symbols: Client Aircraft

Client track

Client aircraft symbol

6nm

2nm
TIS Cockpit Display Symbols: Range Rings

Range rings

- 6 m
- 2 m
- 1 m
TIS Cockpit Display Symbols: Proximity Alert

Azimuth to target

Range to target

$2^n_m$

$6^n_m$

$+15$

2nm

6nm
TIS Cockpit Display Symbols: Proximity Alert

Relative altitude (in hundreds of feet)

Altitude trend (500 ft/min or more)

Ground track vector (to nearest 45°)

6nm

2nm

+15

NTSB
Aural alert when number of traffic alerts increases: “TRAFFIC”
View From Airplane 46 Sec. Before Collision

TIS display: Helicopter

No TIS messages

TIS display: Airplane

“TRAFFIC”
View From Airplane 37 Sec. Before Collision

TIS display: Helicopter

TIS display: Airplane

"TRAFFIC"
View From Airplane 32 Sec. Before Collision

TIS display: Helicopter

TIS display: Airplane

2nm

Airplane

Helicopter

+04

+08

-05

+09

+05
View From Airplane 28 Sec. Before Collision

TIS display: Helicopter

TIS display: Airplane

“TRAFFIC”
View From Airplane 23 Sec. Before Collision

TIS display: Helicopter
- Airplane
  - +10
  - +07
  - +03

TIS display: Airplane
- "TRAFFIC"
  - +07
  - +03
  - -03
  - +04

Helicopter
View From Airplane 14 Sec. Before Collision

TIS display: Helicopter

TIS display: Airplane
View From Airplane 9 Sec. Before Collision

TIS display: Helicopter

TIS display: Airplane
View From Airplane 5 Sec. Before Collision

TIS display: Helicopter

Airplane

+05

Helicopter

+10

TIS display: Airplane

+04

-01

+01
View From Airplane 4 Sec. Before Collision

Helicopter
View From Airplane 3 Sec. Before Collision

Helicopter
View From Airplane 2 Sec. Before Collision

Helicopter
View From Airplane 1 Sec. Before Collision

Helicopter
Summary – Cockpit Visibility

- Airplane: outside helicopter pilot’s field of view during 32 seconds before collision
- Helicopter: inside airplane pilot’s field view at all times
- Helicopter: small, stationary object against background of buildings
- Helicopter: likely hard to see from airplane
Summary – TIS

• System sent messages to both aircraft
• Airplane: received alerts concerning helicopter 46 seconds before collision
• Airplane: possibly no aural alerts concerning helicopter
• Helicopter: received alerts concerning airplane 37 seconds before collision
• Helicopter: likely received two aural alerts concerning airplane
Summary – TIS

• Multiple traffic alerts for both aircraft indicate congested airspace
• Helicopter operations in congested airspace pose unique challenges for design of traffic alerting systems
• Staff proposes recommendations in this area