

# Characterization of Air Traffic Controllers' Visual Search

## Patterns and Control Strategies

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### Works cited:

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Kang, Z., Bass, E.J., and Lee, D.W. (2014). Air traffic controllers' visual scanning, aircraft selection, and comparison strategies in support of conflict detection. In *Proceedings of the 58th Annual Meeting of the Human Factors and Ergonomics Society*. Chicago, IL, 68 (1), pp. 77- 81.



## Introduction

[Video introduction](#)

- Develop a better understanding of experts' visual scanning procedures and conflict mitigation strategies through the analysis of eye movements and verbal protocols in realistic scenarios using a high-fidelity en-route air traffic simulation.

## Background

- To the best of our knowledge, there currently is no literature that systematically shows the potentially different types of visual scanning procedures associated with mitigation strategies.
- Extracting this information from veterans, incorporating it into the multimedia learning materials of candidates, could help expedite and support their transition from novices to experts (Kang & Landry, 2014, 2014; Kang, Bass & Lee, 2014).

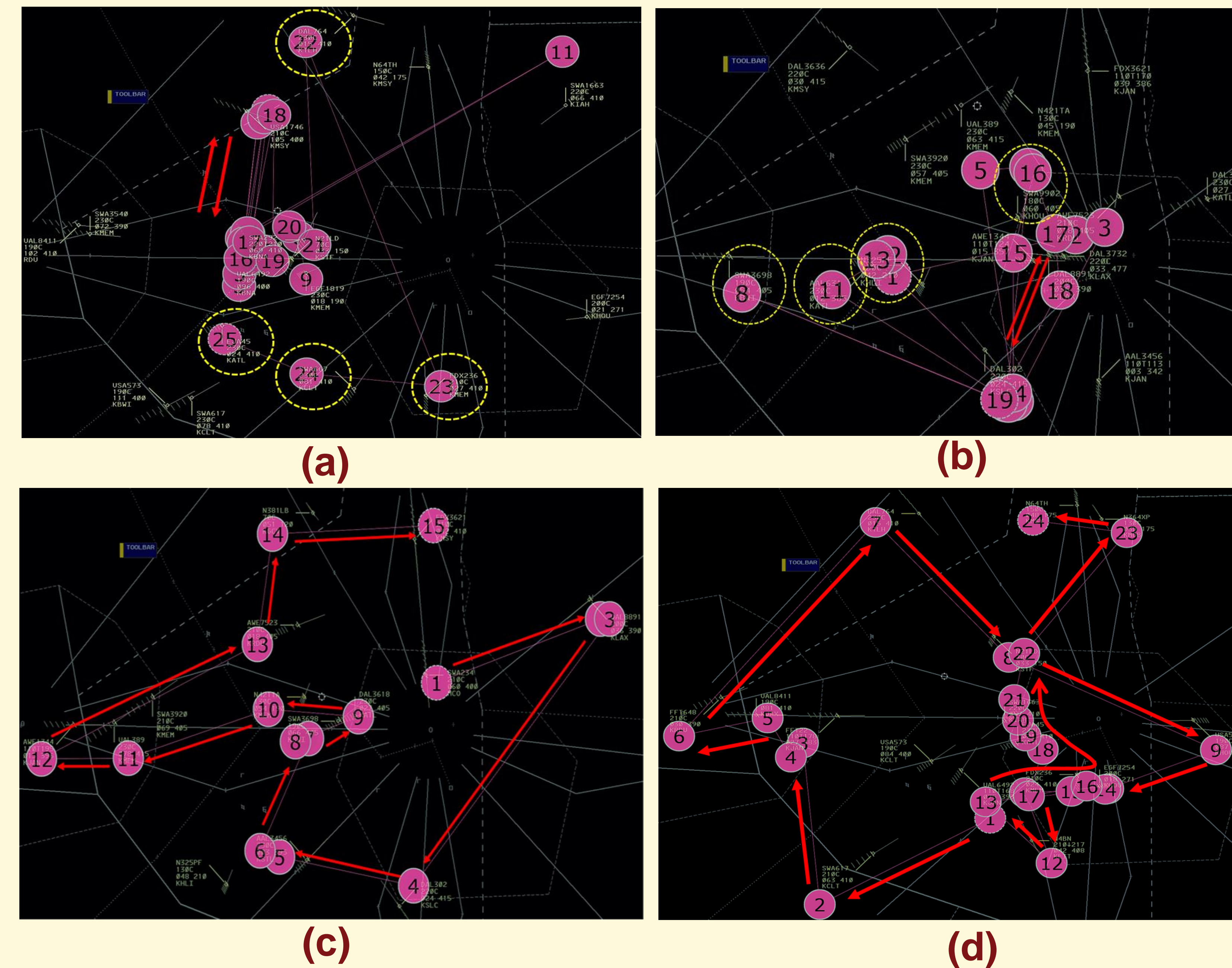
## Research Hypotheses

- Veterans apply visual scanning procedures that differ in their geometrical pattern, as well as in the motivation.
- Veterans utilize distinct situational hierarchical heuristics to process and mitigate conflicts that adapt to the environment.

## Methods

- Eleven veteran air traffic control specialists participated.
- Twelve simple-to-complex high-fidelity scenarios were presented to the ATCSs, who had to identify and, if needed, mitigate potential conflicts.
- Eye movement data were recorded, using a Tobii eye-tracker, and structured interviews were held with the participants' post-experiment.

## Results



Figures (a) and (b) highlight change in eye movements once a conflict has been identified. Yellow circles denote aircraft of interest near the conflict. Red arrows show the movements between the conflicting aircraft.

The visual scanning procedures of veterans can be classified into categories based on their geometrical pattern: circular, linear, spiral and mixed; Figures (c) & (d) showcase representative examples of a circular and mixed cases, respectively.

The participants' responses throughout the interviews were quantified, and where possible, mapped to the geometrical patterns they applied on the scenarios. The table to the left is a representative example of this process.

Geometrical pattern	Freq.	Starting location	Freq.	Participant
Spiral	4	High density-based	3	P2, P10, P11
		Center of sector	1	P9
Circular	2	High density-based	1	P1
		Preference based on training and experience	1	P3
Linear (e.g. zigzag)	1	Low density-based	1	P5
Quadrants	1	Areas of conflict	1	P4
Mixed (circular + linear)	1	High density-based	1	P6
Random	2	Incoming sector traffic	1	P8
		High density-based	1	P7

## Conclusions

Categorized visual scanning patterns into spiral, circular, quadrants, linear and mixed (i.e. two or more scanning patterns combined). In addition, several hierarchical heuristics that veterans utilize to identify (e.g. reading data tag in a set order) and mitigate conflicts (e.g. changing altitudes), as well as the environmental factors that affect them, are reported.