

# VISUAL SCAN PATTERNS IN TOWER CONTROL: FOUNDATIONS FOR AN INSTRUCTOR SUPPORT TOOL



9<sup>th</sup> SESAR Innovation Days

**C. Westin\*** · **K. Vrotsou\*** · **A. Nordman\*** · **J. Lundberg\*** · **L. Meyer‡**

\* Dept. Science & Technology  
Linköping University, Sweden  
*carl.westin@liu.se*

‡ Research & Innovation  
LFV, Sweden

2 – 6 December 2019, Athens, Greece



founding members





# -- RESKILL --

2016-2021



founding members



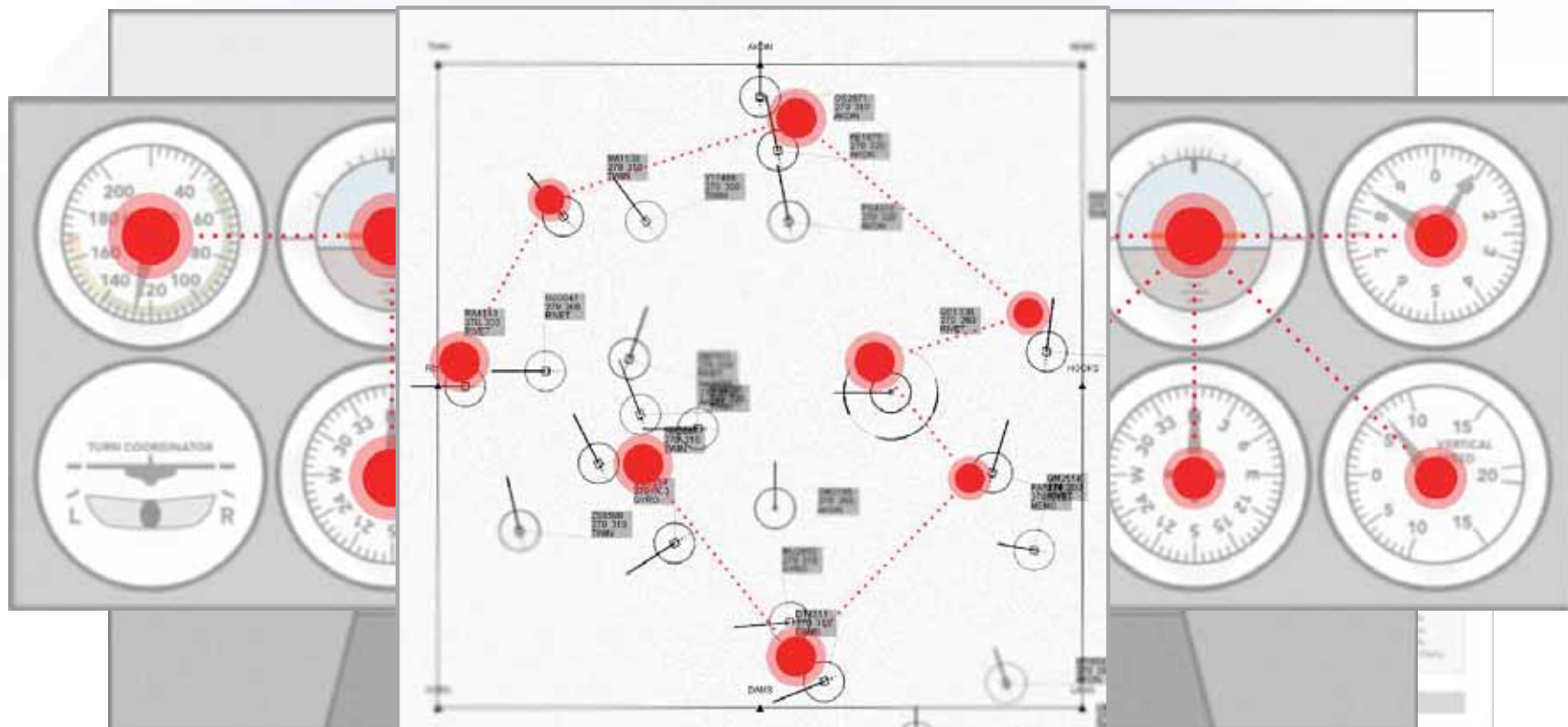


founding members





# VISUAL SCAN PATTERNS



founding members





## TWO QUESTIONS

- 1) What templates of systematic scan patterns that standardize best practices are there in tower control?
- 2) How can these be detected and visualized using an interactive visual sequence mining tool for exploring collected eye-tracking data?



founding members





## METHOD

Collect eye-tracking data



Identify template scan patterns  
(workshop)



Analyze compliance with  
template scan patterns

## SCENARIO

- Single runway
- CAVOK
- Wind 180/4
- Two approaches
- Two departures
- 2 controllers



TOBII Pro Glasses 2



founding members

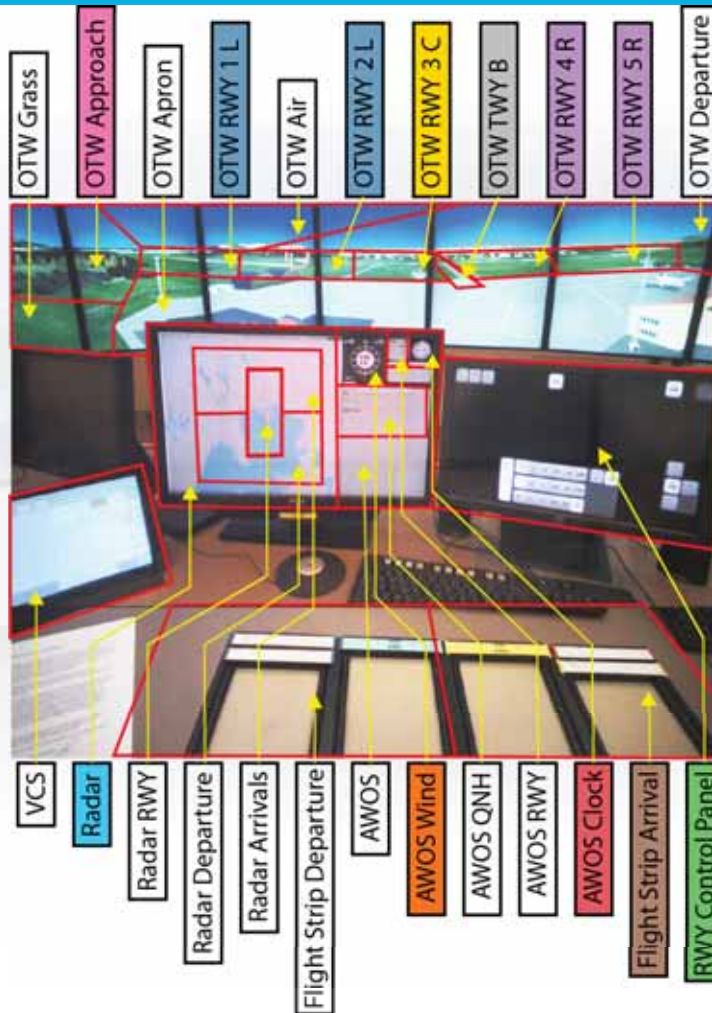


## METHOD

Collect eye-tracking data

Identify template scan patterns  
(workshop)

Analyze compliance with  
template scan patterns



## WORKSHOP

- 3 instructors
- Goal: Identify scan patterns
- Subgoal: Define AOI
- Stimuli
  1. Printed field of view
  2. Tasks analyses (of scenarios)
  3. Demo of eye-tracking recording

# METHOD

Collect eye-tracking data

Identify template scan patterns (workshop)

Analyze compliance with template scan patterns

The screenshot displays the ESCENDAR software interface. At the top, there is a toolbar with icons for Options, File manager, Chat, Tree, Constraints, Sequences, Pattern, Event, Legend, and Video. The main interface is divided into two primary sections: 'Tree' on the left and 'Video' on the right. The 'Tree' section shows a hierarchical 'Pattern Tree View' with a root node and numerous child nodes representing different flight phases and events, such as 'RADAR\_RUNWAY', 'OTW\_APPROACH', 'OTW\_RUNWAY\_1\_L', 'OTW\_RUNWAY\_2\_L', 'OTW\_RUNWAY\_3\_G', 'OTW\_AIR', 'RADAR\_APPROACH', 'RADAR\_RUNWAY', 'OTW\_DEPARTURE', 'OTW\_TAXIWAY\_B', 'AWOS\_CLOCK', 'AWOS\_QNH', 'AWOS\_WIND', 'OTW\_RUNWAY\_4\_R', 'OTW\_RUNWAY\_3\_R', 'STRIP\_ARRIVALS', 'STRIP\_DEPARTURES', 'RADAR\_EDGE', 'RADAR\_DEPARTURE', 'AWOS\_NOTHING', 'RADAR\_APPROACH', 'RADAR\_RUNWAY', 'OTW\_DEPARTURE', 'OTW\_RUNWAY\_3\_R', 'OTW\_TAXIWAY\_B', 'AWOS\_CLOCK', 'STRIP\_DEPARTURES', 'RADAR\_EDGE', 'AWOS\_CLOCK', 'AWOS\_RUNWAY', 'RADAR\_DEPARTURE', and 'AWOS\_NOTHING'. A 'Sequences' section below the tree shows a horizontal timeline with colored bars representing different event sequences. The 'Video' section on the right shows a cockpit view with a central display showing a map and various flight instruments. A 'Sequences' panel at the bottom of the video window shows a sequence of events with a duration of 220. The interface also includes a search bar at the top right and a status bar at the bottom.

**PATTERN TREE VIEW** **ESCHENDAR REVIEW**



## RESULTS

### TEMPLATES OF VISUAL SCAN PATTERNS



1. Runway scan
2. Landing clearance
3. Touchdown and landing roll
4. Phases of visual focus
5. Time glass
6. Wagon wheel

### SUPPORT IN ELOQUENCE



*na*

*na*



founding members



# 1. RUNWAY SCAN



1. AIRCRAFT
2. SCAN RUNWAY L1
3. SCAN RUNWAY L2
4. SCAN RUNWAY C
5. SCAN RUNWAY R1
6. SCAN RUNWAY R2



founding members





## 2. LANDING CLEARANCE

**Data set: Reco2 SAS356 Landing**      **Touchdown: 303034-306035**

OTW RUNWAY 21

Looked at instruments just before touchdown: AWOS\_WIND and clock

Runway scans

1. AIRCRAFT
2. SCAN RUNWAY
3. WIND INSTRUMENT
4. RUNWAY CONTROL PANEL
5. FLIGHT-STRIP

Touchdown

53 Step 5&6      Step 7

OTW\_APPROACH

Runway scan occurs in the dataset

Steps 1, 2, 3, and 4

- OTW\_APPROACH
- OTW\_RUNWAY\_2\_L
- OTW\_RUNWAY\_2\_R
- OTW\_RUNWAY\_3\_L
- OTW\_RUNWAY\_3\_C
- OTW\_RUNWAY\_3\_R
- AWOS\_CLOCK
- OTW\_RUNWAY\_S\_R
- AWOS\_WIND



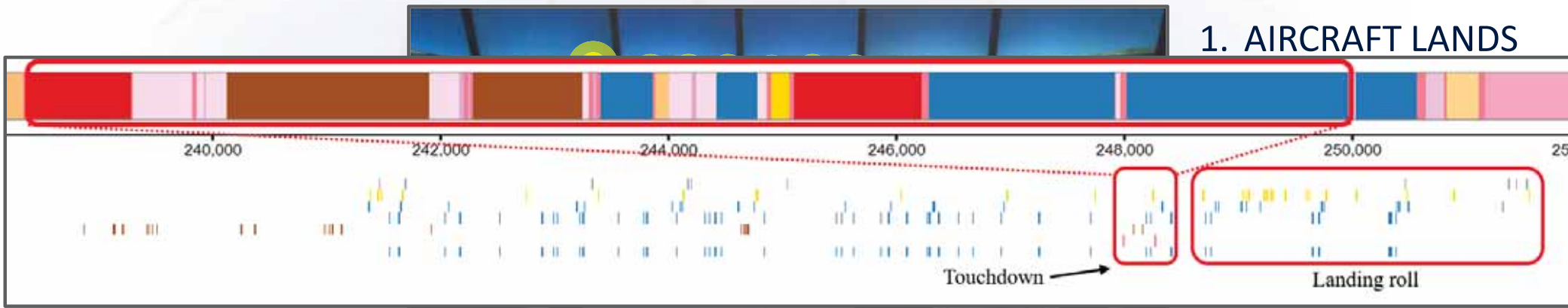
founding members





### 3. TOUCHDOWN AND LANDING ROLL

#### 1. AIRCRAFT LANDS



- Radar
- Runway Control Panel
- Strip arrivals
- AWOS Wind
- OTW approach
- OTW Runway L
- OTW Runway C
- OTW Runway R
- AWOS Clock
- OTW Taxiway

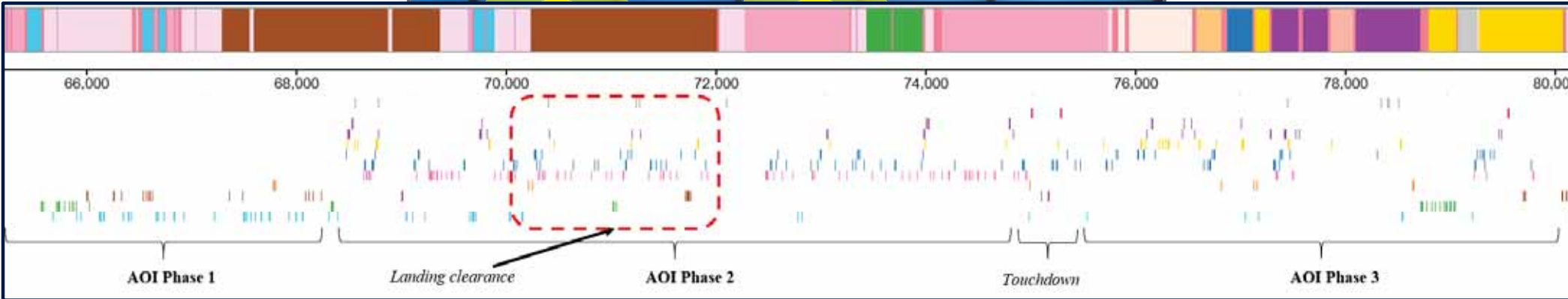


founding members



# 4. PHASES OF VISUAL FOCUS

## 1. RADAR



- Radar
- Runway Control Panel
- Strip arrivals
- AWOS Wind
- OTW approach
- OTW Runway L
- OTW Runway C
- OTW Runway R
- AWOS Clock
- OTW Taxiway

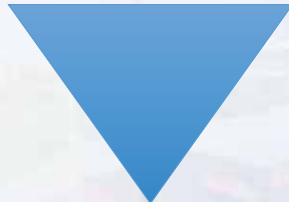


founding members



# 5. TIME GLASS

BEFORE LANDING



*WIDE ATTENTION*

TOUCH DOWN

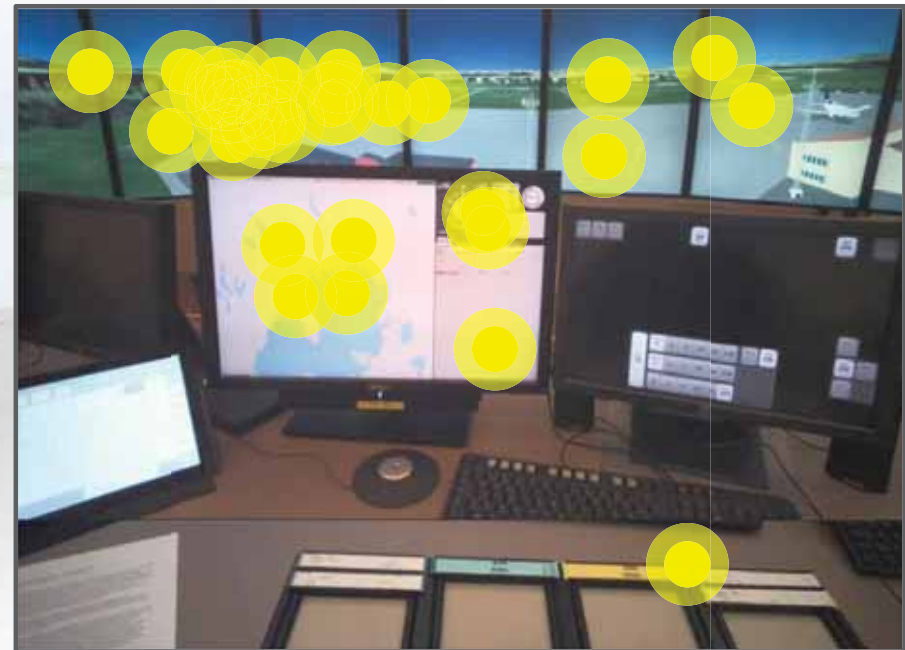


*NARROW ATTENTION*

AFTER LANDING



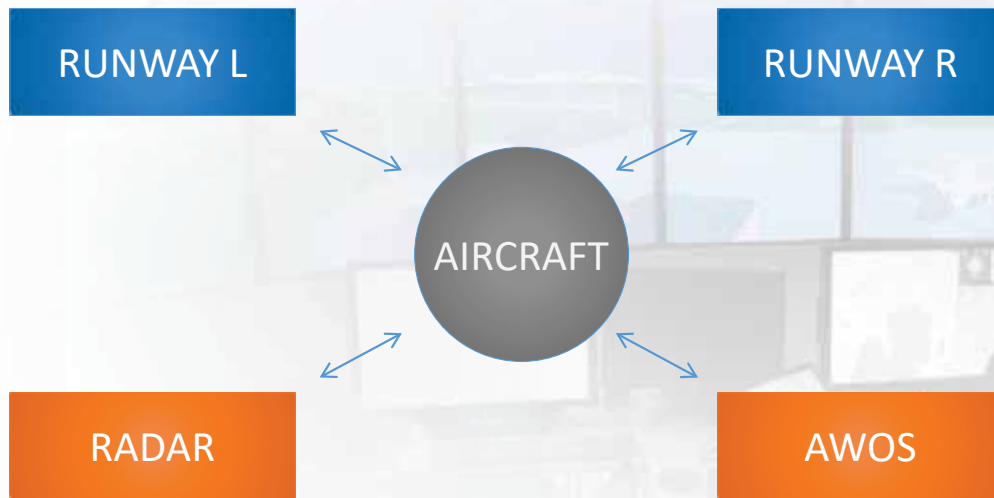
*WIDE ATTENTION*



founding members



## 6. WAGON WHEEL



founding members







## DISCUSSION

### IMPACT

- Teach novices standardized “best practice” scan patterns
- Work as anchor (*checklist*) for visual activity
- Insight to ATCO behavior and performance
- Main application of tool is for after-simulation review
- Self-reflection on performance

### OUTLOOK

- Validate templates
- Explore tool with instructors
- Explore more complex scenarios, other aerodromes
- Automate search and detection of template scan patterns



founding members





# VISUAL SCAN PATTERNS IN TOWER CONTROL: FOUNDATIONS FOR AN INSTRUCTOR SUPPORT TOOL

- **C. Westin** · K. Vrotsou · A. Nordman · J. Lundberg · L. Meyer

*carl.westin@liu.se*



founding members

