MINIMA

MItigating Negative Impacts of Monitoring High Levels of Automation

Founding Members

EUROPEAN UNION EUROCONTROL

Agenda

1. Motivation & Goals
2. „Out-of-the-Loop“-Phenomenon
3. MINIMA Concept
4. Upcoming Evaluation

1. MINIMA – Motivation & Goals

Motivation

- Increasing automation
  - More efficiency, capacity and security
- Role of ATCOs will change
  - From active operator to passive monitor
- Risk: ATCOs get „Out-of-the-Loop" (OOTL)
  - If automation fails, ATCO might not be able to handle situation
  - „Ironies of Automation"

1. MINIMA – Motivation & Goals

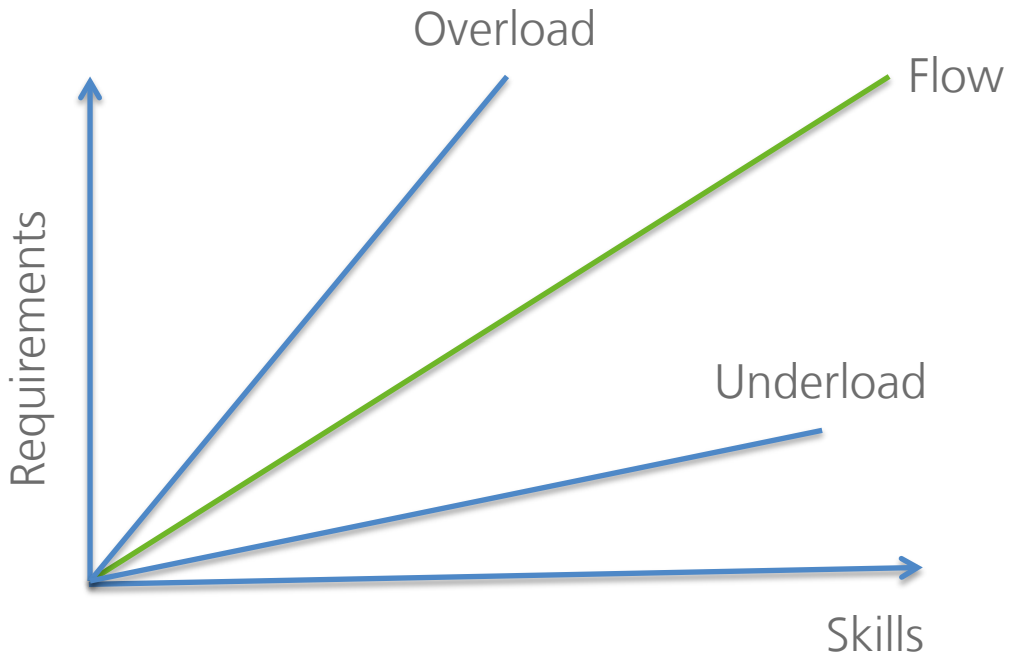
Goals

- Keep automation while mitigating its „Ironies“
  - ➢ Prevent OOTL
- Get to know more about OOTL
  - ➢ Characterisation
  - ➢ Recognition/Prediction
  - ➢ Prevention
- Actively mitigate OOTL
  - ➢ Adaptive Automation

2. „Out-of-the-Loop“

Reasons for OOTL

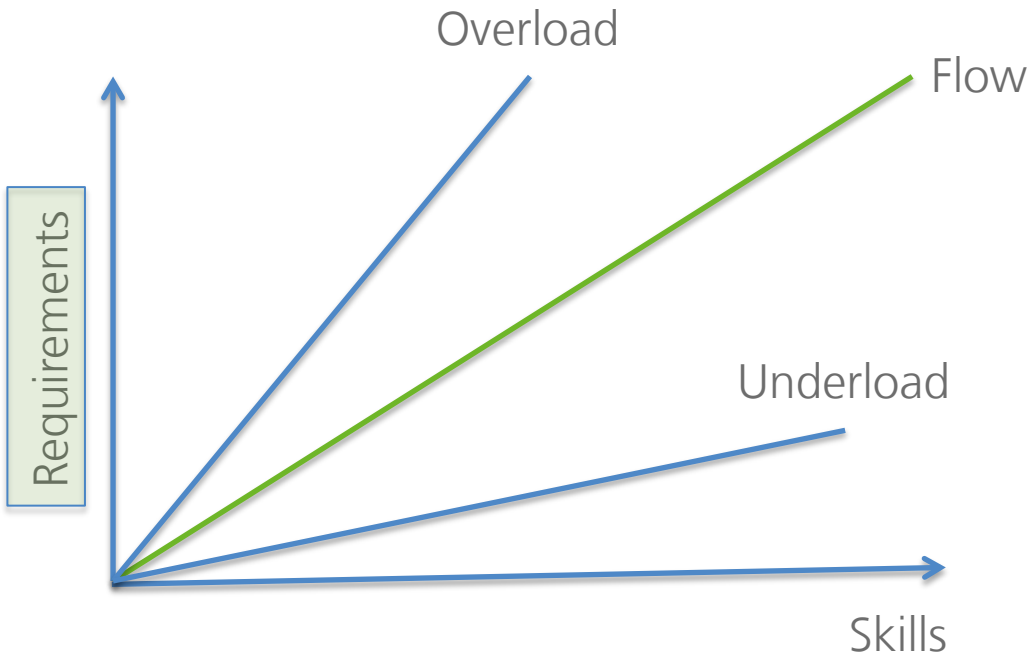
- Automated System → no/little action required
- System non-transparent → hard to comprehend mechanics



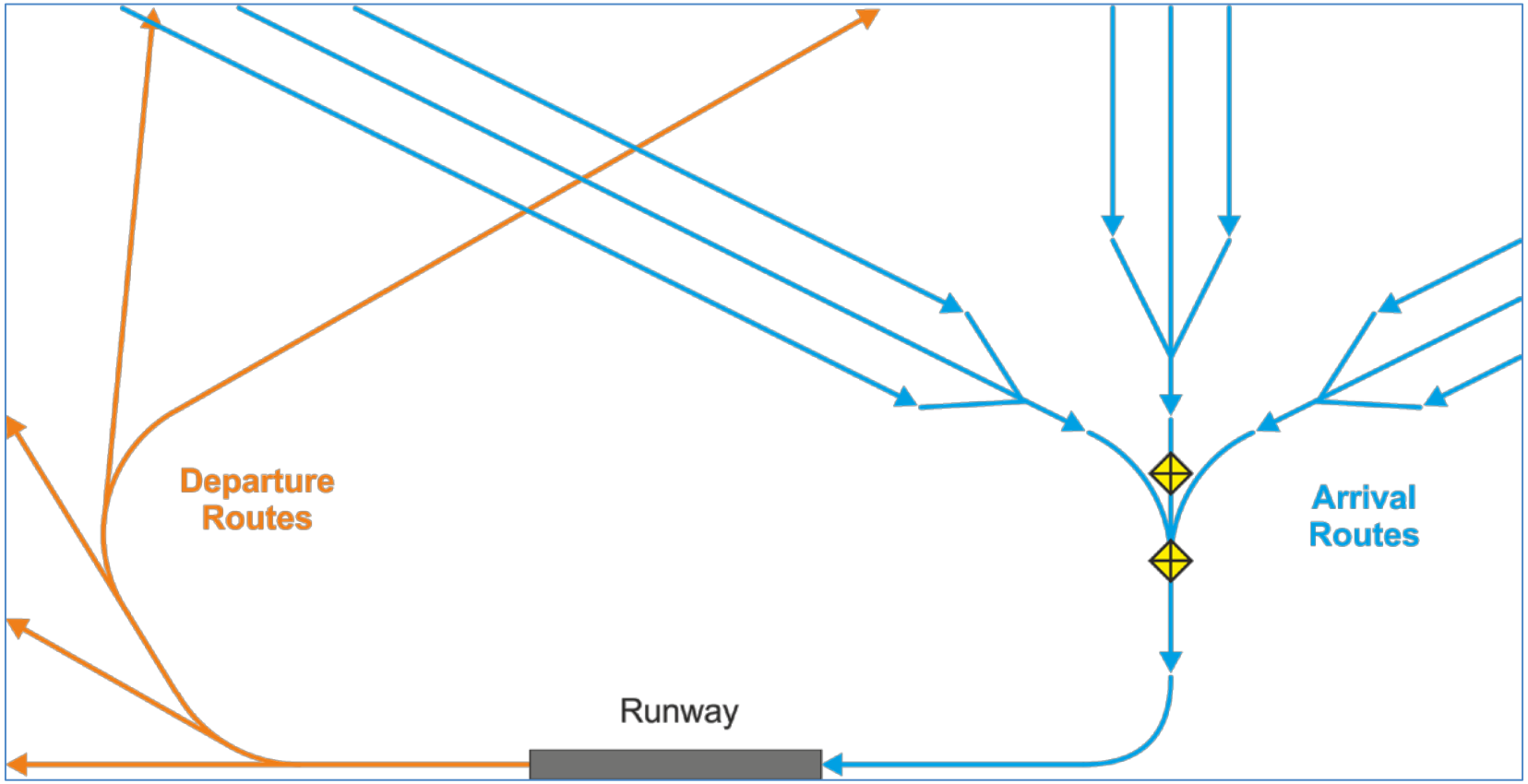
2. „Out-of-the-Loop“

Consequences of OOTL

- Decreasing control due to high trust in the system
- Decreasing Vigilance → Attention →Situation Awareness

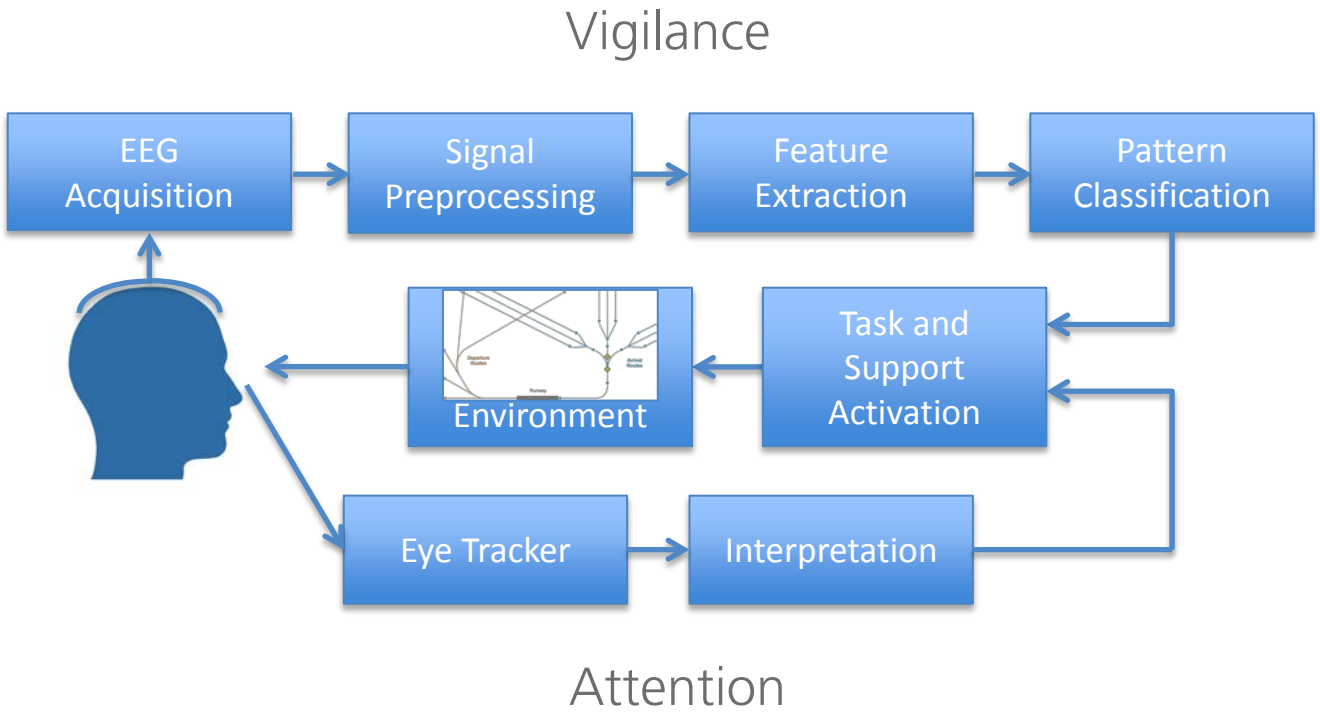


3. MINIMA Concept



3. MINIMA Concept

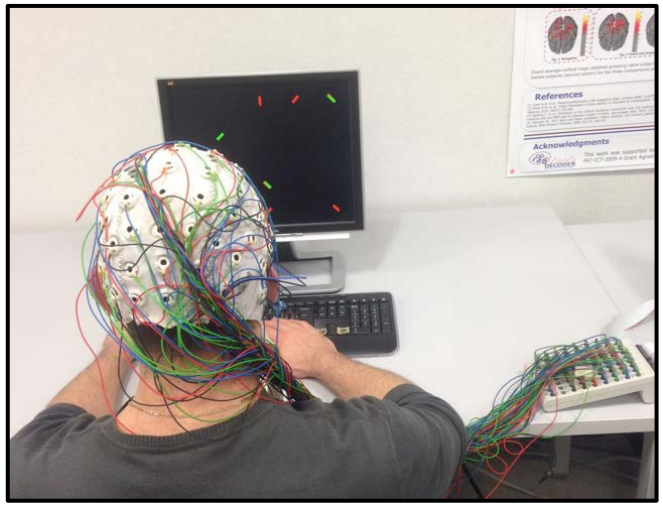
Assess ATCOs mental state



3. MINIMA Concept

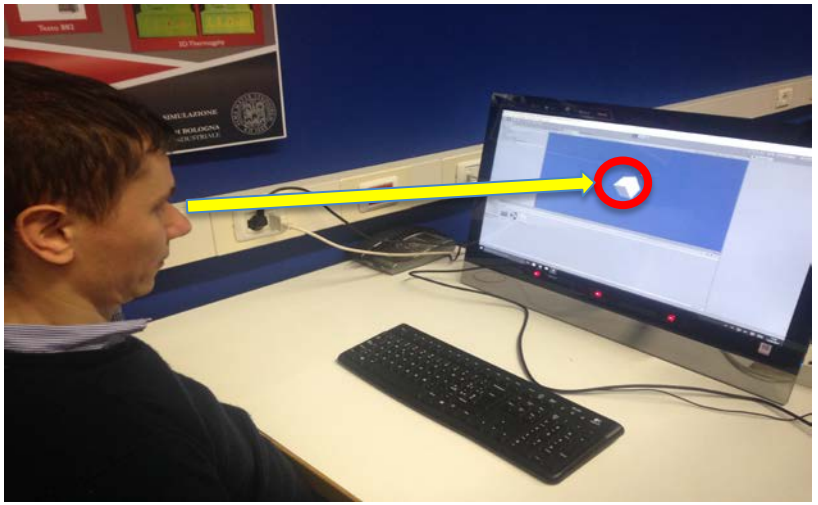
Integrated Vigilance & Attention Controller

Vigilance



BS-Recorder

Attention



Tobii EyeX

3. MINIMA Concept

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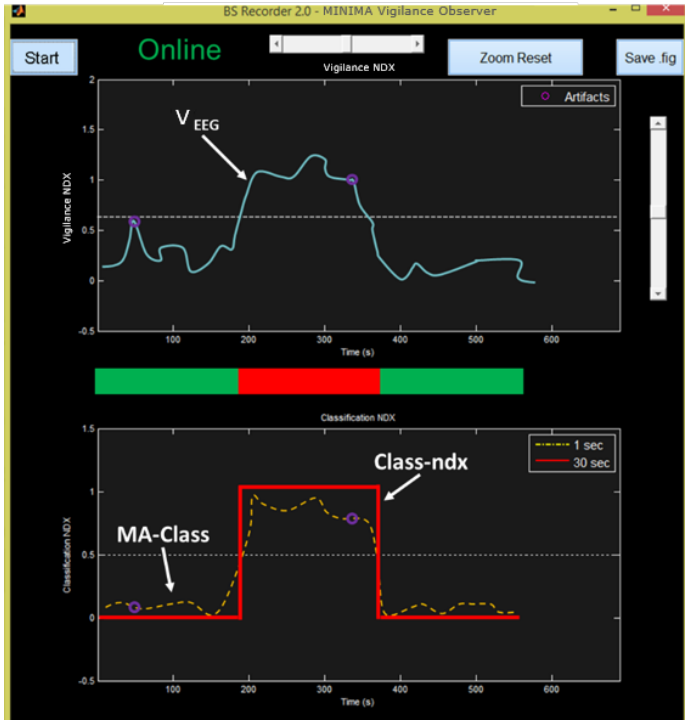
Vigilance



3. MINIMA Concept

Adaptive Automation

Highlighting information

- Loss of separation and close aircraft
- Deviations from route
- Predicted deviations from target time
- Conflicting trajectories
- Not monitored aircraft

Additional information

- Centerline Separation Range
- Advisories

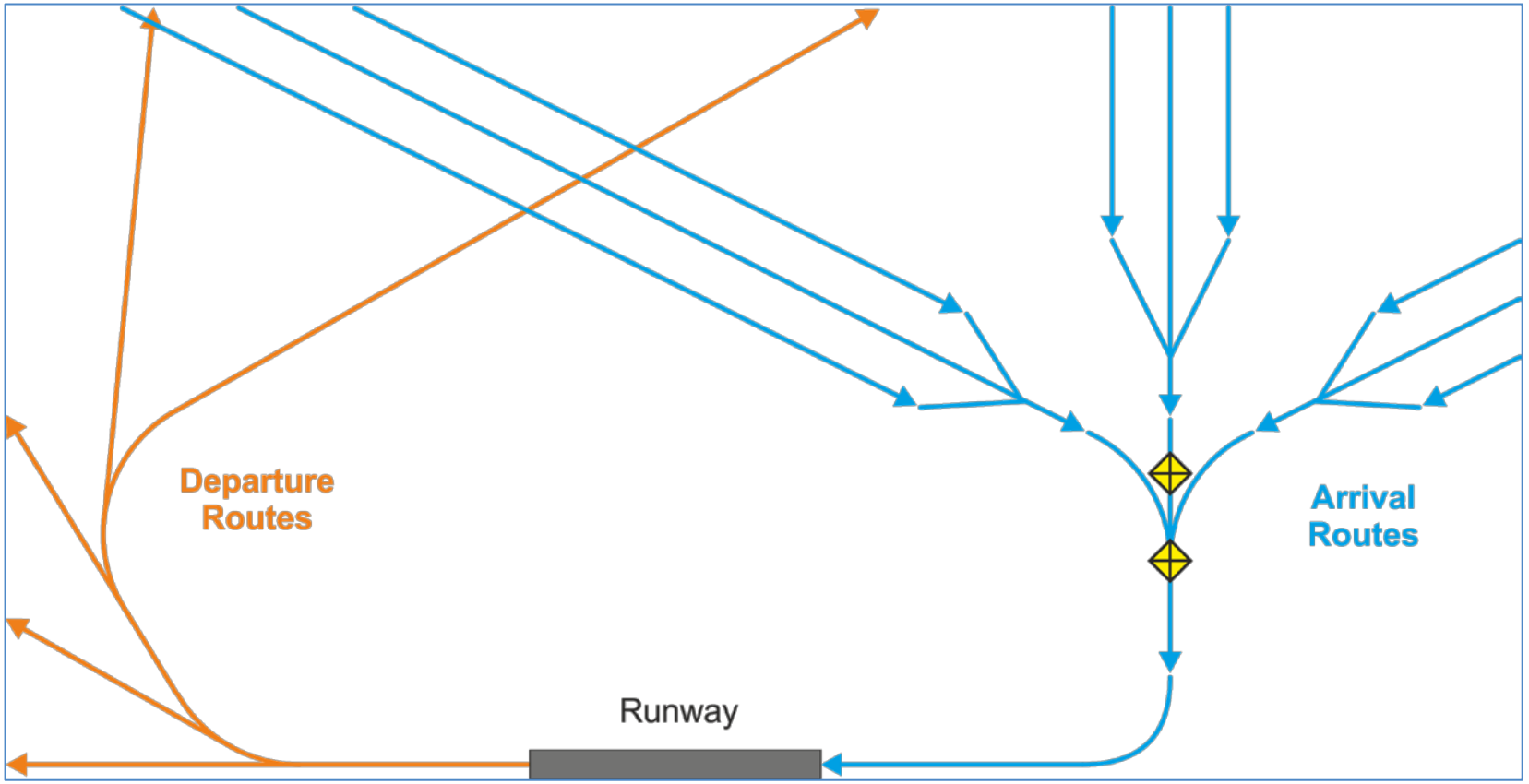
Additional tasks

- Manual vs. automatic hand-overs
- Earlier Hand-overs from adjacent sectors
- Sequence optimization according to customer demand
- Provision of addition information to aircraft

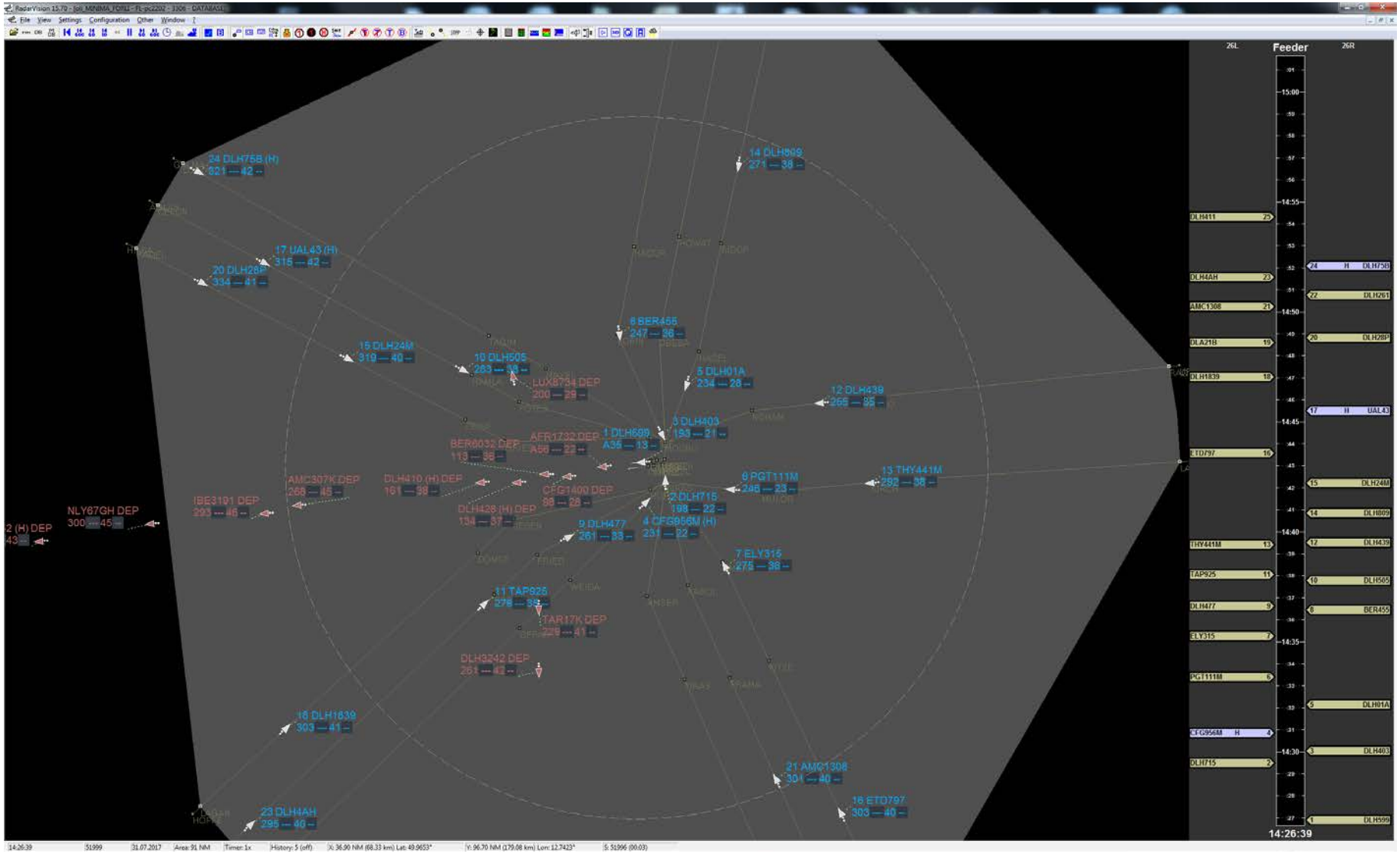
Artificial tasks

- Answer automatically generated questions

3. MINIMA Concept



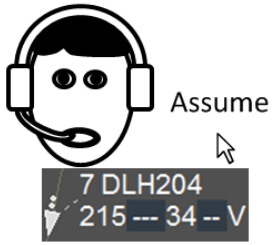
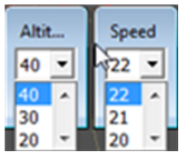
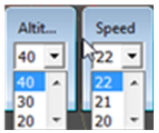
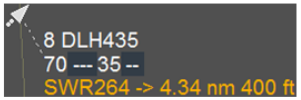
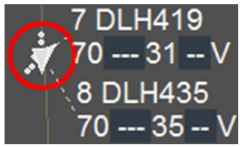
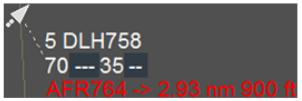
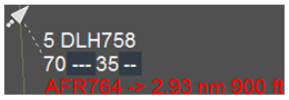
3. MINIMA Concept



3. MINIMA Concept

Simulation Environment

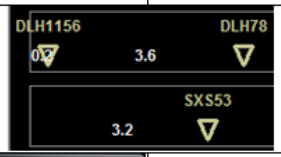
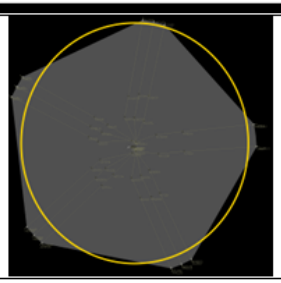
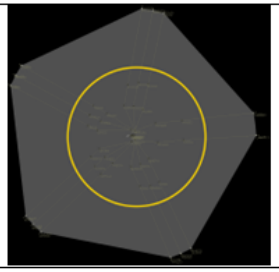
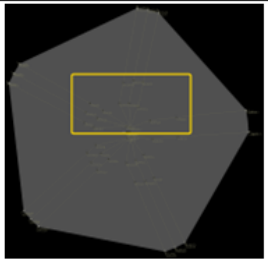
Vigilance

	Level 0	Level 1	Level 2
4.1 (4.3) Air Ground Communication			
4.2 (4.4) Attention Guidance with Eye-Tracker			invisible
4.3 (4.5) Short-Term Conflict Prediction			invisible
4.4 (4.6) Attention Guidance			

3. MINIMA Concept

Simulation Environment

Vigilance

	Level 0	Level 1	Level 2
4.5 (4.7) Attention Guidance Target Times Deviations			Invisible
4.6 (4.8) Centerline Separation Range			invisible
4.7 (4.9) Advisories		invisible	
4.10 (4.12) Adaption of Sector Size			
4.11 (4.13) Training Questions			invisible

4. Planned Evaluation

Expert study in Forlì, Italy

- 15 ATCOs of ENAV
- Baseline vs. MINIMA Concept
  - ➢ High Automation vs. Adaptive Automation
  - ➢ Examine differences in OOTL

Day 1 (without EEG)	Day 2 (with EEG)
Introduction to Simulation	EEG-Reference-Scenarios (2x 5 min.)
Baseline-Training (45 min.)	Baseline-Scenario (45 min.)
MINIMA-Training* (45 min.)	MINIMA-Scenario with EEG (45 min.)
Debriefing	Debriefing

*Manual Automation

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Thank you very much for your attention!

This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No [number]

SESAR JOINT UNDERTAKING

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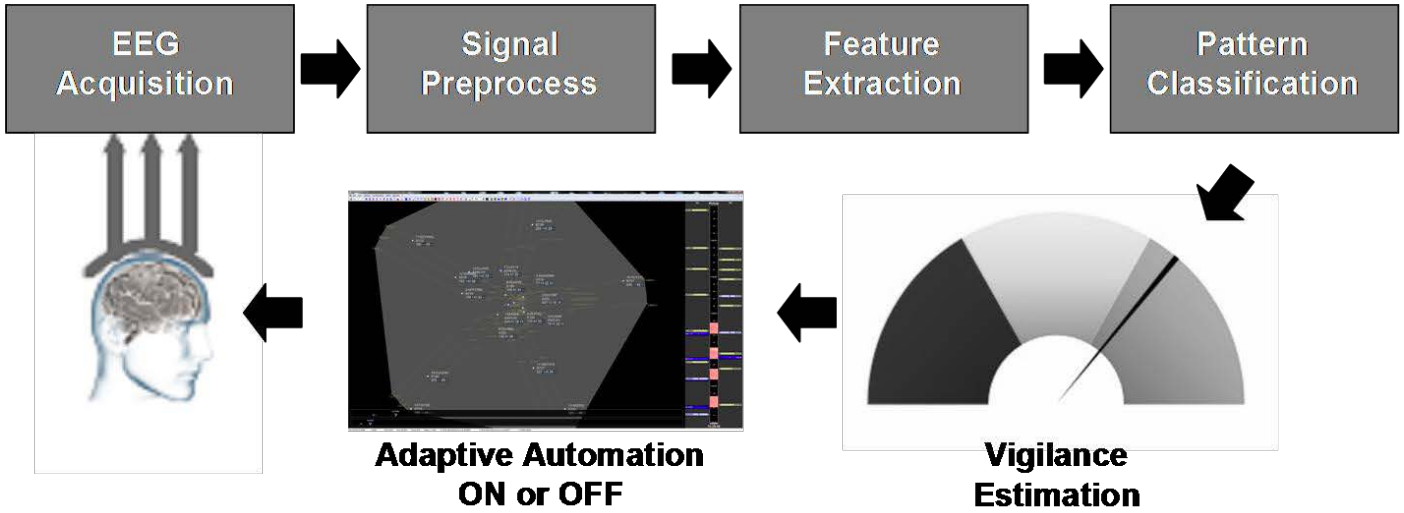
MINIMA Concept

Integrated Vigilance & Attention Controller

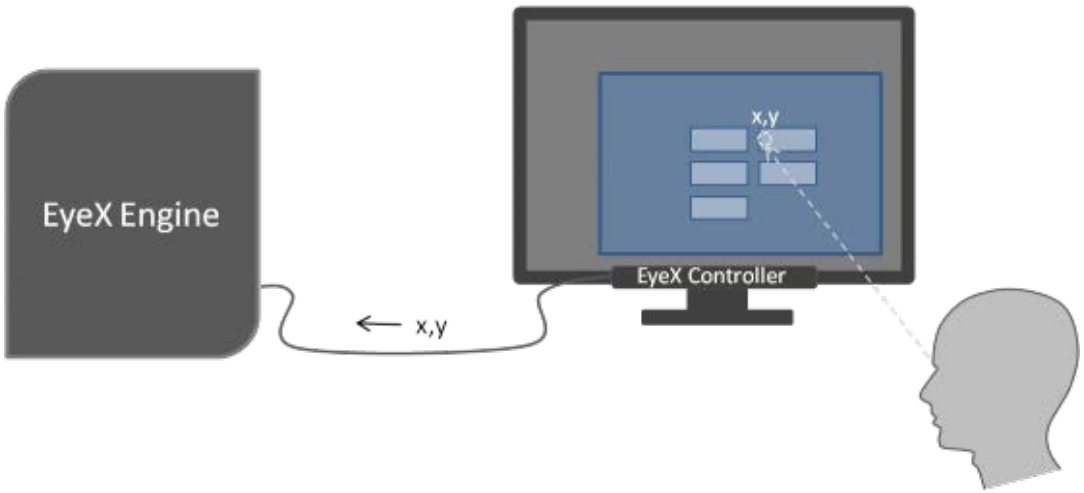
Vigilance



MINIMA Concept

Integrated Vigilance & Attention Controller

Attention



MINIMA Concept

Evaluation Task Environment