Situation awareness of en-route air traffic controllers in the context of automation (SALSA)

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HP Activity Categories:
Assessment of situational awareness [1]

Resource Type:
Technique

Abstract:

SALSA is on-line probe SA measurement technique that was recently developed for air traffic control (ATC) applications. The SALSA technique is administered during simulations ?freezes?, similar to the SAGAT approach. The relevance of the information is determined a posteriori in an expert rating during a replay of the simulation. According to the authors SALSA takes into account air traffic controllers use of event based mental representations of the air traffic and considers the changing relevance of the elements in the environment. The SALSA and the SAGAT measure have been applied in an evaluation study of a future ATM concept (multisector planning).

References

Developer and source:


General Description

Purpose:
SALSA is a method to measure SA in ATC. The SALSA and the SAGAT measure have been applied in an evaluation study of a future ATM concept (multisector-planning). SALSA was especially developed to measure SA in the ATC-domain. It pays special attention to the fact that the relevance the elements of the task environment changes over time.

Type (e.g. observation, questionnaire, interview, checklist, measurement instrument, etc.):
Questionnaire method, measurement

Technical description of method or tool etc

Description of the content/study:
SALSA is a questionnaire method that uses online freeze technique like SAGAT-TRACON. SALSA weights aircraft based on their relevance to the current control scenario.

The SALSA involves expert rating of replay of an air traffic management (ATM) simulation to determine the relevance of each task element (aircraft) to controllers. Only elements that are judged as relevant in the replay are considered for SA queries during subsequent test trials. In addition, rather than having participants recall aircraft positions on a blank radarscope, SALSA involves cued recall, in which participants are given the positions for the aircraft on which they are to be queried. Hauss and Eyferth (2003) assert that this SA measurement approach reduces the possibility of participants confusing two aircraft positions during free recall and take into account the air traffic controllers' use of an event-based mental representation of their task.

The measure is basically a variant of SAGAT (Jeannot et al., 2003); It differs mainly in three ways:
(1) SALSA includes an expert rating of the replay of the simulation to determine the relevance of each item that is asked in the reproduction test. Subsequently, the results of the reproduction tests are weighted with the results of the expert ratings. Weighting refers to considering the relevance of the In SALSA only items that were judged as relevant in the replay are considered. SALSA was also tested whether expert ratings are a suitable way to determine the relevance of aircraft parameters (Hauss et al., 2000). A high inter-rater-reliability (i=.73) between relevance judgements of the experts and a high correlation (r=.54) of the conflict-degree of an aircraft and the number of its parameters that are rated as relevant by the experts was found. In addition the experts were asked to judge the relevance of each aircraft in total on a 5 point scale. This subjective relevance measure correlated highly (r=.64) with the conflict degree. All three mentioned results turned out to be highly significant (p<0.01) (Hauss et al., 2001).

(2) To avoid the possibility of mixing up two aircraft positions with each others in the analysis of a free recall, a cued recall is used in the reproduction test of SALSA. To avoid losing a good indicator for SA the cue of the cued recall should be carefully chosen. Since in usual operation conditions the position of an aircraft is available from the external memory (radar screen) with relatively small cognitive costs and has usually a stable reproduction performance the aircraft position is used as a cue.

(3) During each freezing the complete set of questions is asked for one aircraft. This strategy allows to collect a considerable amount of data within a relatively small number of interruptions. Empirical evidence showed that this approach leads to a tolerable duration of the freezings.

Technical requirements for using the method, tool, etc:
Requires expensive high fidelity simulators and computers

Measure/Response Type:
SALSA is a questionnaire method that uses online freeze technique, when the radar screen is frozen a random aircraft is highlighted. During each interruption the complete set of 15 questions is asked for the highlighted aircraft. SALSA includes an expert rating of the replay of the simulation to determine the relevance of each item that is asked in the reproduction test.

Results obtained and interpretation:
Weighting procedure and performance calculation: the results of expert ratings are weighted with the results of participants S.A. trial. The final score is defined by an equation. Only correct reproduced items that were judged as relevant in the replay are considered.

Evaluation

Advantages:
Recognises the need for a comprehensive assessment of operator SA requirements? for the design of the queries (Jeannot et al., 2003).
Recognise that relevance of the elements of the task environment changes with times and circumstances (Hauss & Eyferth, 2003; Jeannot et al., 2003).
Provides quantitative results.
Cued recall reduces the risk of participants confusing aircraft positions during free recall (Kaber et al., 2006). Avoids problems associated with collecting SA data post trial, e.g. correlation with performance, forgetting etc. (Salmon et al., 2006).

Disadvantages:

- Interruption of the natural flow of the task (Jeannot et al., 2003).

- The weighting procedure occurs after the simulation: only the relevance of answers is taken into account, not the relevance of questions (Jeannot et al., 2003).

- Intrusive to primary task performance (Jeannot et al., 2003).

- Limited use/validation (Salmon et al., 2006; Stanton et al., 2005).

- Queries may overload the participant (Stanton et al., 2005).

- Requires expensive simulators and computers (Stanton et al., 2005).

- May interfere with other measurements (Jeannot et al., 2003).

Alternative Methods:

SAGAT, SART

**Usability (ease of use, efficiency, effectiveness)**

Ease of use:
- medium

Efficiency:
- medium

Effectiveness:
- medium

Constraints concerning conditions of use:

SALSA is best suited for laboratory studies and as a stand-alone measure. Is not suited for ?real world? environment. It is recommended to brief the participants before starting, and conduct a pilot run.

Reliability:

A high inter-rater-reliability (i=.73) between relevance judgements of the experts and a high correlation (r=.54) of the conflict-degree of an aircraft and the number of its parameters that are rated as relevant by the experts is reported by the authors.

Validity:

n/a

Required effort (to conduct & to analyse):

Medium effort is required.
Level of HF expertise needed (required user qualification)

HF specialist needed for using the technique.

High: high level of expertise required, only for experts, lots of training required
Other expertise needed (required user qualification):

Subject matter expert (SME) required.

Cost Information

n/a

Experiences of use by SESAR partners (including references):

not available

Reported and/or published experiences of use (including references):

The application of SALSA is feasible, but still can be improved. A taxonomy of characteristic features of the traffic situation out of which the relevance of each aircraft parameter can be concluded, could replace the expert rating and save evaluation costs and time.

Hauss, Y., Gauss, B. & Eyferth, K. -2001- SALSA: a new approach to measure situation awareness in Air traffic control. 4th USA/Europe Air Traffic Management RAD Seminar.

Applicability to lifecycle phase (E-OCVM):

V2-V3

Application Area:

SALSA was developed mainly for use in Air traffic control domain.

Keywords:

Situation Awareness, Measurement, Air Traffic Control, Simulation.

Short Description:

SALSA is on-line probe SA measurement technique similar to the SAGAT approach but especially developed for air traffic control (ATC) applications. The SALSA technique is administered during simulations ?freezes? and a set of questions asked.

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