Results of Dissemination, Communication, and Exploitation

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Copyright Statement

HAAWAII

HIGHLY ADVANCED AIR TRAFFIC CONTROLLER WORKSTATION WITH ARTIFICIAL INTELLIGENCE INTEGRATION

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Abstract

The SESAR2020 Wave 2 Exploratory Research project HAAWAII (**H**ighly **A**dvanced **A**ir Traffic Controller **W**orkstation with **A**rtificial **I**ntelligence **I**ntegration) aims to research and develop a reliable, error resilient, and adaptable solution to automatically transcribe and annotate voice commands issued by both air traffic controllers and pilots to enable further applications.

This document contains and details the results of Dissemination, Communication, and Exploitation of the HAAWAII project based on the Project Management Plan. It defines objectives, outlines the strategy, explains the process to declare high-level messages, identifies the target audience, proposes a schedule, gives an overview on concrete activities as well as their formats, and presents success criteria. As well the contributions by partners will be described in detail.

The document describes the outreach of the HAAWAII project achieving a maximum effort for European taxpayers.

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1. Introduction

The project will build on very large collection of data, organized with a minimum expert effort to develop a new set of models for complex environments of Icelandic en-route area and London TMA. HAAWAII aims to perform proof-of-concept trials in challenging environments, i.e. to be directly connected with real-life data from ops room. HAAWAII targets to significantly enhance the validity of the speech recognition models to even enable pilot read-back error detection. HAAWAII will improve safety while reducing controllers' workload. The digitization of controller and pilot voice utterances can be used for a wide variety of safety and performance related benefits including, but not limiting to pre-fill entries into electronic flight strips and CPDLC messages. Another HAAWAII application is to objectively estimate controllers' workload utilizing digitized voice recordings of the complex London TMA. Hence, there are many aspects from the scientific and technical concept via implementation of prototypic applications to validation results that should be communicated to a broader audience.

This document details the dissemination, communication, and exploitation aspects of the HAAWAII project based on chapter 4 of the Project Management Plan. It defines objectives, outlines the strategy, explains the process to declare high-level messages, identifies the target audience, proposes a schedule, gives an overview on concrete activities as well as their formats, and presents success criteria.

Within the HAAWAII project there are many aspects that should be subject to dissemination, communication, and exploitation such as:

- Scientific concepts including speech recognition process, machine learning, and neural networks, transcription rules, annotation ontology, functionalities using air traffic controller and pilot "assistant based speech recognition"
- Implemented prototypes for e.g. readback error detection; workload estimation; pre-filling entries into electronic flight strips and CPDLC messages to be applied either to Iceland en-route area or London terminal maneuvering area (TMA)
- Validation results based on real-life data from operation's room of above-mentioned complex air traffic control (ATC) environments

These intermediate results of the project will be disseminated, communicated, and exploited online and on-site to the relevant audience[1], in an appropriate form, and following a respective strategy with measurable success throughout and after the project runtime as described in the following sections.

The project will make sure that it's effort, ongoing tasks and development in scientific and aeronautical areas are visible to the community and partners.

[1] *The current coronavirus (Covid-19) situation in Europe and worldwide of course requires some flexibility.*

2. Communication and Dissemination Objectives and Strategy

Within the project and after the finalization of the project from T0+24 until T0+30 months, we will strongly push on possible industrialization activities of the technologies developed. Within the consortium, four air navigation service providers (ANSPs), i.e. NATS, Isavia, Austro Control, and Croatia Control are present to foster this.

Although, HAAWAII does not have the capacity to address software safety and complex integration activities which are essential in ATM, the consortium will have the chance to collaborate closely with ANSPs' experts implying fast move in bringing the technology into real-word applications.

Furthermore, we aim to early integrate industry partners into the progress and outcomes of HAAWAII. They are needed to support 24/7 operations with respect to enable ANSPs to adapt static data for speech recognition applications in a real-life environment later. Therefore, stakeholder workshops and demonstration days, as well as exhibition and information at fairs were detained. Scientific publications were disseminated to describe the project content and efforts in detail.

In addition, the speech recognition community is targeted next to ATM stakeholders. One of the biggest speech recognition events – the Interspeech 2021 conference – was hosted by the HAAWAII partner BUT in Brno in August/September 2021. HAAWAII organized a special session at the conference, allowing to review the automatic speech recognition achievements in context of other works.

Complementary information were shared via channels such as the project website. Further information can be found in this document in section 5.6 Further Activities.

3. Project High Level Messages

HAAWAII communicated its three main messages as targeted in the beginning of the project and updated and complemented these messages with implementation and validation results respectively:

- HAAWAII aims to increase **air traffic controller (ATCO) productivity** by pre-filling radar labels and call-sign highlighting.
- HAAWAII aims to do the first, but significant step to **increase air traffic management (ATM) safety** by automatically detecting readback errors.
- HAAWAII aims to show that **modern speech recognition techniques** can bring a **high accuracy**, even when applied on pilot speech from a potentially noisy channel.
- HAAWAI aims to **reduce ATCOs' workload**. The digitization of controller and pilot voice utterances can be used to pre-fill entries into electronic flight strips and CPDLC messages.
- HAAWAII aims to objectively **estimate ATCOs' workload** utilising digitized voice recordings of the complex London TMA.

From these high-level messages of the project the following objectives can be derived:

- **Obj1:** Exploiting massive amounts of unlabelled voice data through new **unsupervised learning algorithms**.
- **Obj2:** Automatic speech **recognition** of the controller and **pilot** communication for the very complex London TMA and for Isavia's enroute airspace.
- **Obj3:** Automatic detection of pilot **readback errors**.
- **Obj4: Pre-filling** of radar labels and CPDLC messaging.
- **Obj5:** Improve ATCo staffing, rostering and flow management planning and reaction for the London TMA by **measuring** and anticipating the **workload** from voice communication.
- **Obj6:** Sufficiently consider **data privacy** issues.

4. Target Audience Identification

The following target groups have been identified to be relevant for all or some aspects of the HAAWAII project:

1) ATM industry, ATC organisations,
2) ANSPs, including ATCOs and pilots,
3) Government organisations,
4) System developers, other Small and Medium-sized Enterprises (SMEs),
5) ANSP supervision organizations,
6) Standardization bodies, e.g.
   a. EUROCAE Technical Advisory Committee (TAC),
   b. EUROCAE Council,
   c. RTCA, and/or
   d. ISO TC4/WG2 or NIST – the U.S. National Institute of Standards and Technology, which organizes many challenges for processing speech or text data,
7) Scientific and research community.

The task 3.1 of HAAWAII aims to enable ANSPs to update static data for speech recognition applications by their own, e.g. adding new waypoints or airline designators. In general, ANSPs often do the configuration work of the software on their own, updates of the software are often done by the industry partner. However, software adaptation and enabling 24/7 operation will require that ANSPs either adapt the developed software by their own or get industry partners involved. Therefore, dissemination and exploitation will get industry on board as soon as possible.

Two **stakeholder workshops** plus two **demonstration days** (one event of them is combined) were held for this purpose (between Summer 2021 and Summer 2022)[2] in the two-and-a-half years project runtime. Furthermore, participation in the ATM World congress (CANSO) was detained by HAAWAII partners. The scientific and research community were especially involved through scientific papers, presentations at conferences, and the project website information. On top of that, a special session focused on automatic speech recognition in ATM was organised during the Interspeech conference in Brno from 30th August to 3rd September 2021 (co-chaired by the project coordinator Prof. Helmke).

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5. Schedule of Communication, Dissemination, and Exploitation Activities

The following table 1 presents the foreseen list of Communication, Dissemination, and Exploitation events.

Table 1 Communication, Dissemination, and Exploitation Events.

Title	Subject	Date	Place
First Stakeholder Workshop	Getting intermediate feedback from ATM stakeholders	28./29.June 2021 (T0+13)	~~Vienna, Austria~~ → online
Organisation of special session on Interspeech 2021 conference	Overview of the HAAWAII results in the context of other works related to automatic speech recognition in ATM	2021-08-30 to 2021-09-03 (T0+16)	Brno, Czech Republic
Satellite Meeting during Interspeech 2021	Discussing results and challenges with speech recognition community	2021-08-30 to 2021-09-03 (T0+16)	Brno, Czech Republic
First Demonstration Day	Presentation of first results to selected industrial partners	5th to 6th of May 2022 (T0+24)	Reykjavik, Iceland
Second Stakeholder Workshop with integrated Second Demonstration Day	Presentation of project results to ATM community and potential industry partners	27th to 28th September 2022 (T0+28)[3]	Swanwick, Great Britain

[3] According to grant agreement deliverables can be delivered after T0+24, so we only have a Project presentation at T0+28.

5.1.First Stakeholder Workshop

A stakeholder workshop is one way to engage stakeholders – those who are affected by, have a direct interest in, or are somehow involved with the project, and gatekeepers – those who control access to people or resources needed. The project team invites stakeholders and gatekeepers to a workshop to seek their input on the proposed project and to achieve consensus in open questions.

Engaging and receiving input from stakeholders and gatekeepers is critical to the success of an exploratory research project. Conducting this stakeholder workshop helps to understand the context for the project and receive support from key players.

The first stakeholder workshop has taken place 28./29.June 2021. It was hosted by Austro Control and due to COVID-19 organized as a virtual meeting. The results are published in D6-1.

5.2. First Demonstration Day

The first demonstration day has taken place 5th to 6th of May 2022. It was hosted at Isavia ANS premises and the purpose of the event was to run demonstration trials and present the intermediate results to the potential industry partners, SJU and operational community.

Already during the proposal phase, two key industry partners - Frequentis and Rohde and Schwarz - have shown their support for the HAAWAII project. Among others, the HAAWAII consortium is planning to invite representatives of the two players to the first and the second demonstration day.

There was one full day session presenting the project details using presentations and a demonstration session in the operational environment. During the presentation sessions, the following topics were covered: technical presentation with the architecture and how the ABSR is connected to the operational environment, presentation of the results from previous tests, improvements that affected the results, presentation of HAAWAII applications, operational use cases and operational benefits of the project, and future plans. During the demonstration session, the ABSR was connected to the Isavia operational system (ED137 Recorder voice stream and ASTERIX CAT062 surveillance data) and the ATCO communicated with pilots. The results from the ASBR was displayed, such as callsign identification and command annotation due to the ontology. As readback errors are not that common in operation, part of the communication was according to script to generate a readback error alert from the ASBR. The ATCO informed the pilot upfront regarding the intention of simulating a readback error and asked the pilot to intentionally provide the wrong readback.

At the end of the sessions, there have been an open discussion with the participants. The scopewas to discover other benefits or applications beside the ones presented during the demonstration and the level of interest.

The project team regularly updated the project website www.haawaii.de with the status of the project process with respect to this event.

5.3. Satellite Meeting during Interspeech 2021

The idea is to bring more attention of the speech processing community to air-traffic communication. Interspeech is one of the most important events for speech processing community worldwide. The annual conference attracts usually more than 3,000 individuals from all around the world to present research works in the domain of audio and speech processing. It is also well perceived and attended by industry, including the major companies such as Google, Facebook, Amazon, or Apple.

This HAAWAII satellite event was motivated by the past workshop organised by AIRBUS in 2018, bringing together researchers from ASR community to help in automatically transcribing the ATCOs' speech[4].

Interspeech 2021 satellite meeting was technically organised by HAAWAII partner BUT and thus this was the perfect occasion to organise a parallel event on automatic transcription and understanding of ATC communication.

More information about the satellite meeting is provided via HAAWAII website.

https://www.haawaii.de/wp/interspeech-special-session-automatic-speech-recognition-in-air-traffic-management-asr-atm/

The following two tables shows that four of the nine planned presentations are with contributions from HAAWAII partners and that HAAWAII partners are providing the introductory talk and leading the following panel discussion.

[4] https://arxiv.org/abs/1810.12614, https://www.irit.fr/SAMOVA/site/pagechallenge-airbus-atc-workshop.html

Table 2 Presentation from HAAWAII partners during the satellite meeting at Interspeech 2021 (part 1).

Agenda:	
Hartmut Helmke (DLR) Overview and Introduction of the Satellite Workshop	**14:00**
Raquel Garcia Lasheras (CRIDA), Adrián Fabio, Fernando Celorrio, Juan Albarrán, Nadal Ceñal, Carlos Pinto de Oliveira, Cristina Bárcena Martín, Julián Chaves Cáceres and Mhamed Fillal Kilch Flight callsign identification on a Controller Working Position	**14:15**
Iuliia Nigmatulina (Idiap), Rudolf Braun, Juan Pablo Zuluaga and Petr Motlicek Improving callsign recognition with air-surveillance data in air-traffic communication	**14:30**
Shuo Chen (MITRE), Hunter Kopald, Weiye Ma, Robert Tarakan and Yuan-Jun Wei Air Traffic Control Speech Recognition	**14:45**
Amrutha Prasad (Idiap), Juan Pablo Zuluaga, Petr Motlicek, Oliver Ohneiser, Hartmut Helmke, Seyyed Saeed Sarfjoo and Iuliia Nigmatulina Grammar Based Identification Of Speaker Role For Improving ATCO And Pilot ASR	**15:00**

Table 3 Presentation from HAAWAII partners during the satellite meeting at Interspeech 2021 (part 2).

Fernando Celorrio (CRIDA), Adrián Fabio, Raquel Garcia Lasheras and Carlos Pinto de Oliveira Workload calculation based on Air Traffic Controllers' utterances using Automated Speech Recognition	**15:45**
Petr Motlicek (Idiap), Pavel Kolcarek The ATCO2 project: Creating a commonly available data base for training ATC ASR models Website	**16:00**
Pavel Kolcarek (Honeywell CZ): Honeywell's roadmap for a perfect Speech Recognition Engine for ATC on-board application	**16:10**
Hartmut Helmke (DLR), Shruthi Shetty, Matthias Kleinert, Oliver Ohneiser, Heiko Ehr, Amrutha Prasad, Petr Motlicek, Aneta Cerna and Christian Windisch How to Measure Speech Recognition Performance in the Air Traffic Control domain? The Word Error Rate is only half of the truth!	**16:20**
Approx. 25 minutes of Questions and Answers and the Future of ASR in ATM	**16:35**
End	**17:00**

Additionally, a special session was planned, in addition to other standard conference sessions, related to automatic speech recognition in ATM, with oral or poster presentations (depending on the interest of potential participants). This allowed HAAWAII partners as well as other active players interested in automatic speech recognition (i.e. in general in speech processing) in ATM domain to participate and share their experience with the whole speech community as well as with ATM experts. We also took the advantage of the close cooperation between BUT and Honeywell Aerospace (the Brno hub is Honeywell's largest and most modern research centre in Europe) and involved experts from the company in the workshop organisation.

More information about the special session on ATM and ASR is provide via HAAWAII website.

https://www.haawaii.de/wp/interspeech-2021-agenda-for-special-session-on-automatic-speech-recognition-in-air-traffic-management-is-now-online/

The following table shows that four of the six presentations are with contributions from HAAWAII partners and that HAAWAII partners are providing the introductory talk and leading the following panel discussion.

Table 4 Presentation from HAAWAII partners at the special session at Interspeech 2021

- 11:00 *Introduction*
- 11:10 **Thu-M-SS-2-1** 333 *Towards an Accent-Robust Approach for ATC Communications Transcription*, Nataly Jahchan, Florentin Barbier, Ariyanidevi Dharma Gita, Khaled Khelif and Estelle Delpech
- 11:25 **Thu-M-SS-2-2** 1033 *Detecting English Speech in the Air Traffic Control Voice Communication*, Igor Szöke, Santosh Kesiraju, Ondřej Novotný, Martin Kocour, Karel Veselý and Jan Černocký
- 11:40 **Thu-M-SS-2-6** 935 *Robust Command Recognition for Lithuanian Air Traffic Control Tower Utterances*, Oliver Ohneiser, Saeed Sarfjoo, Hartmut Helmke, Shruthi Shetty, Petr Motlicek, Matthias Kleinert, Heiko Ehr and Šarūnas Murauskas
- 11:55 **Thu-M-SS-2-3** 1373 *Contextual Semi-Supervised Learning: An Approach to Leverage Air-Surveillance and Untranscribed ATC Data in ASR Systems*, Juan Zuluaga-Gomez, Iuliia Nigmatulina, Amrutha Prasad, Petr Motlicek, Karel Veselý, Martin Kocour and Igor Szöke
- 12:10 **Thu-M-SS-2-4** 1619 *Boosting of Contextual Information in ASR for Air-Traffic Call-Sign Recognition*, Martin Kocour, Karel Veselý, Alexander Blatt, Juan Zuluaga Gomez, Igor Szöke, Jan Černocký, Dietrich Klakow and Petr Motlíček
- 12:25 **Thu-M-SS-2-5** 1650 *Modeling the Effect of Military Oxygen Masks on Speech Characteristics*, Benjamin Elie, Jodie Gauvain, Jean-Luc Gauvain and Lori Lamel
- 12:40 *Panel discussion*

5.4.World ATM Congress

DLR presents the REDA demo shown at first HAAWAII demo day at the World ATC Congress in Madrid (21st to 23rd June 2022). DLR also showed the docker demo version from Reykjavik demo day (May 2022) so that visitors test with their own voice. DLR has also shown at the World ATC Congress (WAC) the demonstrator from the STARFiSH project including a Wacom display for apron controllers. Voice-to-Text is from Idiap, Wacom software from ATRiCS.

5.5. Second Stakeholder Workshop with Integrated Second Demonstration Day

The second Stakeholder Workshop took place at NATS facilities from 27th to 28th of September 2022 and was integrated into a demo day. All project members from HAAWAII, as well as partners from industry and research attended at the workshop and demo day. The workshops were hold on the second day of the event.

The main aim of the event was to showcase the results and achievements of the HAAWAII project over the last two years with a focus on workload metrics extraction and analysis. Not only did the project team present their successes, but also provided the opportunity, for attendees in person, to

experience the speech recognition and understanding capabilities and try them for themselves. This demonstration was based on traffic data recorded in May 2022 in UK airspace. Participants could pretend to be a pilot and/or controller and put the software to test. One highlight was the real time read back error detection as well as the fast recognition speed and detailed HMI which showed both surveillance and recognised speech data in real time.

The audience was particularly impressed by the software's reliable detection of various accents, different intonations and even phraseology deviations. Great interest was created especially from participants involved in ATC training and simulation service providers.

On the second day the audience was split into workshop groups, with topics such as adaptation to new environments, various applications and a deeper look into how speech data can be used to objectively measure controller workload. Rich discussions were had and the findings presented back to the entire audience.

In summary, the event provided a great opportunity to disseminate the project results amongst interested stakeholders and generated great discussions as to where to take this technology next to generate tangible benefits for the industry.

Results are provided via the HAAWAII homepage by blogs, see https://www.haawaii.de/wp/second-haawaii-demo-day-at-nats-in-swanwick-summary/.

5.6. Publications in Proceedings and at Conferences

The following contributions were presented:

1. Interspeech 2021 in Brno
   First Results on Recognition Performance on Pilot Voice Data (Lead BUT), 4 papers from the HAAWAII project team are submitted.
   The following papers are presented at the special session:

   a. *Detecting English Speech in the Air Traffic Control Voice Communication*, Igor Szöke (Brno University of Technology, Czech Republic), Santosh Kesiraju (Brno University of Technology, Czech Republic), Ondřej Novotný (Brno University of Technology, Czech Republic), **Martin Kocour** (Brno University of Technology, Czech Republic), Karel Veselý (Brno University of Technology, Czech Republic) and Jan Černocký (Brno University of Technology, Czech Republic)
   b. *Robust Command Recognition for Lithuanian Air Traffic Control Tower Utterances*, **Oliver Ohneiser (**DLR, Germany), Seyyed Saeed Sarfjoo (Idiap Research Institute, Switzerland), Hartmut Helmke (DLR, Germany), Shruthi Shetty (DLR, Germany), Petr Motlicek (Idiap Research Institute, Switzerland), Matthias Kleinert (DLR, Germany), Heiko Ehr (DLR, Germany) and Šarūnas Murauskas (Oro navigacija, Lithuania)
   c. *Contextual Semi-Supervised Learning: An Approach to Leverage Air-Surveillance and Untranscribed ATC Data in ASR Systems*, **Juan Zuluaga-Gomez** (Idiap Research Institute, Switzerland), Iuliia Nigmatulina (Idiap Research Institute, Switzerland), Amrutha Prasad (Idiap Research Institute, Switzerland),

Petr Motlicek (Idiap Research Institute, Switzerland), Karel Veselý (Brno University of Technology, Czech Republic), Martin Kocour (Brno University of Technology, Czech Republic) and Igor Szöke (ReplayWell, Czech Republic)

d. *Boosting of Contextual Information in ASR for Air-Traffic Call-Sign Recognition*, **Martin Kocour** (Brno University of Technology, Czech Republic), Karel Veselý (Brno University of Technology, Czech Republic), Alexander Blatt (Universität des Saarlandes, Germany), Juan Zuluaga Gomez (Idiap Research Institute, Switzerland), Igor Szöke (Brno University of Technology, Czech Republic), Jan Černocký (Brno University of Technology, Czech Republic), Dietrich Klakow (Universität des Saarlandes, Germany) and Petr Motlicek (Idiap Research Institute, Switzerland)

The following papers were presented at the Satellite Meeting:

- **Iuliia Nigmatulina (Idiap)**, Rudolf Braun, Juan Pablo Zuluaga and Petr Motlicek: Improving callsign recognition with air-surveillance data in air-traffic communication
- **Amrutha Prasad** (Idiap), Juan Pablo Zuluaga, Petr Motlicek, Oliver Ohneiser, Hartmut Helmke, Seyyed Saeed Sarfjoo and Iuliia Nigmatulina: Grammar Based Identification Of Speaker Role For Improving ATCO And Pilot ASR
- **Hartmut Helmke (DLR)**, Shruthi Shetty, Matthias Kleinert, Oliver Ohneiser, Heiko Ehr, Amrutha Prasad, Petr Motlicek, Aneta Cerna and Christian Windisch: How to Measure Speech Recognition Performance in the Air Traffic Control domain? The Word Error Rate is only half of the truth!

2. SESAR Innovations Days 2021

    - Applying the standard framework DeepSpeech for speech to text transformation (Lead DLR)

        - M. Kleinert, N. Venkatarathinam, H. Helmke, O. Ohneiser, M. Strake, T. Fingscheidt: Easy Adaptation of Speech Recognition to Different Air Traffic Control Environments using the DeepSpeech Engine, 11th SESAR Innovation Days, online conference, 2021.

    - Presentation of Metrics for evaluation of Speech Recognition Applications in ATM environments:

        - H. Helmke, S. Shetty, M. Kleinert, O. Ohneiser, H. Ehr, A. Prasad, P. Motlicek, A. Cerna and C. Windisch: Measuring Speech Recognition And Understanding Performance in Air Traffic Control Domain Beyond Word Error Rates, 11th SESAR Innovation Days, online conference, 2021.

3. Three submission were planned for Interspeech 2022 in Incheon, Korea in September 2022 The following papers were submitted and not accepted:

    - J. Zuluaga-Gomez, A. Prasad, I. Nigmatulina, S. Sarfjoo, P. Motlicek, M. Kleinert, H. Helmke, O. Ohneiser “How pre-trained Wav2Vec2.0 performs on

domain-shifted ASR? An extensive benchmark on air traffic control communications". Interspeech 18-22.9.2022, Incheon, Korea

- J. Zuluaga-Gomez, S. Sarfjoo, A. Prasad, I. Nigmatulina, P. Motlicek, K. Ondrej, O. Ohneiser, H. Helmke "BERTraffic: a robust text-based speaker change detection and speaker role identification system for air-traffic communications". Interspeech 18-22.9.2022, Incheon, Korea.

4. SESAR Innovations Days 2022 (Budapest, December 2022)

   - Results of Workload Estimation Using Automatic Speech Recognition (Lead DLR and NATS). This paper was not eventually considered for submission.
   - Instead, following 5 papers were submitted and accepted by SID programme committee.
     - M. Kleinert, H. Helmke, S. Shetty, O. Ohneiser, H. Ehr, I. Nigmatulina, H. Wiese, M. Maier, „Apron Controller Support by Integration of Automatic Speech Recognition with an Advanced Surface Movement Guidance and Control System".
     - Ohneiser et al. (with Indra, LDO, ON, ACG, HC zu Sol97) "Understanding Tower Controller Communication for Support in Air Traffic Control Displays".
     - Helmke et al. "Readback Error Detection by Automatic Speech Recognition and Understanding".
     - Amrutha Prasad, Juan Zuluaga-Gomez, Petr Motlicek, Saeed Sarfjoo, Iuliia Nigmatulina Oliver Ohneiser, Hartmut Helmke: "Grammar Based Speaker Role Identification for Air Traffic Control Speech Recognition".
     - Amrutha Prasad, et al., Speech and Natural Language Processing Technologies for Pseudo-Pilot Simulator.

5. ATM Seminar 2021/2023

   - One paper (led by DLR) on the challenges of readback error detection is submitted for the ATM seminar in 2021.
     - Hartmut **Helmke**, Matthias Kleinert, Shruthi Shetty, Oliver Ohneiser, Heiko Ehr, Hörður Arilíusson, Teodor S. Simiganoschi Amrutha Prasad, Petr Motlicek, Karel Veselý, Karel Ondřej, Pavel Smrz, Julia Harfmann, Christian Windisch: *Readback Error Detection by Automatic Speech Recognition to Increase ATM Safety*
   - Readback Error Detection, 2023 (Lead DLR)
     This is still planned.

6. DASC 2021/2022/2023

   - One paper (led by DLR) on command extraction and standardization of interfaces is submitted by DLR for the DASC 2021

- Matthias **Kleinert**, Hartmut Helmke, Shruthi Shetty, Oliver Ohneiser, Heiko Ehr, Amrutha Prasad, Petr Motlicek, Julia Harfmann: Automated Interpretation of Air Traffic Control Communication: The Journey from Spoken Words to a Deeper Understanding of the Meaning

- One submission for DASC 2022 (Lead DLR) was planned
  The paper was not submitted due to lack of time

- One submission for DASC 2023 (Lead DLR) is planned
  This is still planned.

7. AHFE 2022

- One paper from DLR submitted and accepted:
  S. Shetty, H. Helmke, M. Kleinert, O. Ohneiser: Early Callsign Highlighting using Automatic Speech Recognition to reduce Air Traffic Controller Workload, International Conference on Applied Human Factors and Ergonomics (AHFE), 24 - 28 July 2022, New York, USA

8. SLT 2023

The following two submissions were not planned, but were prepared in 2022 and accepted. They will be presented at SLT in January 2023:

- Gomez, J., Sarfjoo, S. S., Prasad, A., Nigmatulina, I., Motlicek, P., Ohneiser, O., and Helmke, H. "BERTraffic: BERT-based Joint Speaker Role and Speaker Change Detection for Air Traffic Control Communications", 2023 IEEE Spoken Language Technology Workshop (SLT), Doha, Qatar, 2023.
- Zuluaga-Gomez, J., Prasad, A., Nigmatulina, I., Sarfjoo, S., Motlicek, P., Kleinert, M., Helmke, H., Ohneiser, O. and Zhan, Q. "How Does Pre-trained Wav2Vec2. 0 Perform on Domain Shifted ASR? An Extensive Benchmark on Air Traffic Control Communications", 2023 IEEE Spoken Language Technology Workshop (SLT), Doha, Qatar, 2023.

9. ICASSP 2022

The following paper was presented on the speech and signal processing conference ICASSP 2022. The paper is as follows:

- A two-step approach to leverage contextual data: speech recognition in air-traffic communications, Nigmatulina Iuliia, Zuluaga-Gomez. Juan, Amrutha Prasad, Seyyed Saeed Sarfjoo and Petr Motlicek, in: Proc. of IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2022.

5.7. Further Activities

Links to communication channels and opportunities managed by the SJU (e.g. SESAR e-News issues, events with SESAR representation) are provided as applicable in STELLAR.

The HAAWAII project has two further deliverables with respect to communication, dissemination, and exploitation. Hence, the results of the stakeholder workshop will be reported for project partners and SJU in D6.1 at T0+28 months. Furthermore, the results of dissemination, communication, and exploitation based on this plan (D6.4) that were continuously updated internally, are reported in this document at T0+30 months after the six-month dissemination phase has ended.

HAAWAII Project Website:

The HAAWAII project has created a public website (www.haawaii.de) hosted by DLR that is continuously updated with latest information.

Currently (status 04-11-2022) 36 blogs have been posted on the HAAWAII website.

Table 5 Summary of presented blogs on HAAWAII homepage

Partner	DLR	BUT	Idiap	ACG	Isavia ANS	NATS
Number of Blogs (Status August 2021)	12	2	3	1	1	1
Number of Blogs (Status January 2022)	15	3	4	1	1	2
Number of Blogs (Status 04 November 2022)	22	3	4	1	2	4

SJU Webinar – ASR Presentations

The SESAR JU, together with key European aviation partners, are organising a series of webinars on the topic of artificial intelligence (AI) linked to a report that was published 2020: https://www.sesarju.eu/index.php/node/3533. As part of the series, on the 23 of March (2:00-3:30pm CET), the SESAR JU will organise a webinar dedicated to AI research and Hartmut Helmke will participate to provide the research perspective on what has already been achieved and what still needs to be done to make AI in ATM a reality.

On the 11 May 2021, the SESAR JU has hosted a webinar under the umbrella of the SESAR Digital Academy, this time the webinar invited four leaders of European projects addressing speech recognition applications in Air Traffic Management. The purpose of the webinar was to give a technical overview of on the status of European speech recognition research, showcase research results and explore what's on the horizon for new research and innovation in the field.

Video

A short video demonstrating the challenges of readback error detection is created and can be accessed via the HAAWAII homepage https://www.haawaii.de/wp/https://www.haawaii.de/wp/

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5.8. Miscellaneous

- Contribution to 2022 results brochure
- Contribution research results brochure

6. Communication and Dissemination Success Criteria

It is not only important to have many communication and dissemination activities, but also to ensure a good quality of them. We use the metrics adapted from the MALORCA project (Machine Learning of Speech Recognition Models for Controller Assistance) to evaluate success:

- Communication activities with respect to research publications:
    - Number of papers submitted to conferences or journals respectively
    - Acceptance rate of papers
    - Feedback in conferences (to presentations and papers)
- Dissemination activities:
    - Number of organized workshops (one workshop at least)
    - Participants in workshops
        - Different organizations (> 8)
        - Number of attendees (>20)
        - Feedback from workshops participants
    - Number of organized demonstration days (one demonstration day at least)
    - Participants in demonstration days
        - Different organizations (> 4)
        - Number of attendees (>10)
        - Feedback from demonstration day participants

7. Evaluation of Communication and Dissemination Activities

There have been multiple communication and dissemination activities during the whole project phase. Especially the events with physical contact (which was limited due to covid-19), had a strong impact of the communication and dissemination activities. The different types of communication and dissemination activities, such as stakeholder workshops, demo days, the world ATM congress and other activities in context to Interspeech supports a strong distribution of the content.

In the following we provide the results with respect to the success criteria agreed on, when the HAAWAII project was started. See the initial draft 6-4 of this Communication, Dissemination and Exploitation Plan, which are also repeated in chapter 7 of this report.

- Communication activities with respect to research publications:
    - Number of papers submitted to conferences or journals respectively
    - Acceptance rate of papers
    - Feedback in conferences (to presentations and papers)

Table 6 Success Rate of Publications

Interspeech 2021 in Brno: • Special Session: 7 papers submitted, 4 accepted, see section 5.6: • Satellite Meeting: 3 presentations submitted and accepted, see section 5.6: SESAR Innovations Days 2021: • 2 papers submitted, 2 accepted, see section 5.6: Interspeech 2022 in Incheon, Korea • 2 paper submitted and rejected, see section 5.6: SESAR Innovations Days 2022 in Budapest: • 5 papers submitted, 5 accepted, see section 5.6: ICASSP 2022 conference in Singapore • 1 paper accepted, see section 5.6: ATM Seminar 2021 • 1 paper submitted and accepted, see section 5.6:

DASC 2021

- 1 paper submitted and accepted, see section 5.6:

AHFE 2022

- 1 paper submitted and accepted, see section 5.6:

SLT 2023

- 2 papers submitted and 2 accepted, see section 5.6:

All in all: 20 papers submitted to conferences and 15 accepted, i.e. 75% and three presentations given at Satellite workshop of Interspeech.

- Dissemination and exploitation activities:
  - Number of organized workshops (one workshop at least)

    Results: Two were organized, i.e. 100% more!
  - Participants in workshops
    - Different organizations (> 8)

      Result: >10
    - Number of attendees (>20)

      Results: The workshop 1 was organized by Austro Control in June 2021. 70 participants were attending this virtual workshop, see https://www.haawaii.de/wp/344-2/ https://www.haawaii.de/wp/344-2/
    - Feedback from workshops participants; see D6-1
  - Number of organized demonstration days (one demonstration day at least)

    Results: 2 was the target and two were organized.
  - Participants in demonstration days
    - Different organizations (> 4)

      Results: (21 for NATS demo day, 45 participated in the demo day organized at Isavia, roughly 25 organizations participated in the first HAAWAII workhshop organized by Austro Control.
    - Number of attendees (>10)

Results:
25 people attended the demo day in May 2022 in Reykjavik in person. Together with the people attending only virtually, > 100 people were benefitting from HAAWAII results, see https://www.haawaii.de/wp/a-successful-first-demo-day-for-the-haawaii-project-in-reykjavik/
https://www.haawaii.de/wp/a-successful-first-demo-day-for-the-haawaii-project-in-reykjavik/

More than 50 people attended the second hybrid workshop organized by NATS in Swanwick: https://www.haawaii.de/wp/second-haawaii-demo-day-at-nats-in-swanwick-summary/

- Feedback from demonstration day participants, see D6-1

The summary of all deliverables and publications can be accessed via the HAAWAII homepage at www.haawaii.de. www.haawaii.de.

8. Annex Stakeholder Workshop Poster

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Horizon 2020
European Union Funding
for Research & Innovation

HAAWAII

HIGHLY AUTOMATED AIR TRAFFIC CONTROLLER WORKSTATIONS WITH ARTIFICIAL INTELLIGENCE INTEGRATION

Virtual Stakeholder Workshop

Monday 28 June 2021, starts 13:00 CET (until approx. 16:00)
Tuesday 29 June 2021, starts 13:00 CET (until approx. 16:00)

Speech Recognition Systems for Air Traffic Control

- **Presentation of the intermediate project outcomes**
- **Discussions in small parallel Working Groups**

More details: www.haawaii.de/wp/events/

The workshop is designed for air navigation service providers especially addressing the end users which includes ATCOs and pilots, but as well as experts from domain of data science, machine learning, speech processing and recognition, aviation authorities, human factors and ATM industry.

Pre-registration is mandatory!
Please express your interest in participation as soon as possible to:
astrid.guby@austrocontrol.at

Virtual hosted by Austro Control,
Wagramer Straße 19, 1220 Vienna, Austria
www.austrocontrol.at

Founding Members