



The Airbus Air Traffic Control speech recognition 2018 challenge: towards ATC automatic transcription and call sign detection

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Abstract

In this paper, we describe the outcomes of the challenge organized and run by Airbus and partners in 2018 on Air Traffic Control (ATC) speech recognition. The challenge consisted of two tasks applied to English ATC speech: 1) automatic speech-to-text transcription, 2) call sign detection (CSD). The registered participants were provided with 40 hours of speech along with manual transcriptions. Twenty-two teams submitted predictions on a five-hour evaluation set. ATC speech processing is challenging for several reasons: high speech rate, foreign-accented speech with a great diversity of accents, noisy communication channels. The best ranked team achieved a 7.62% Word Error Rate and a 82.41% CSD F1-score. Transcribing pilots' speech was found to be twice as harder as controllers' speech. Remaining issues towards solving ATC ASR are also discussed in the paper.

Index Terms: speech recognition, air traffic control, specialized language

1. Introduction

The recent advances in Automatic Speech Recognition (ASR) and Natural Language Understanding (NLU) technologies have opened the way to potential applications in the field of Air Traffic Control (ATC).

On the controllers' side, it is expected that these technologies will provide an alternative modality for controllers. As a matter of fact, controllers have to keep track of all the clearances they emit, this is nowadays made either by mouse input or by hand – which generates a high workload for controllers. The ongoing research project MALORCA¹, for instance, aims at improving ASR models for providing assistance at different controller working positions.

On the pilots' side, ASR of ATC messages could also help decreasing pilots' cognitive workload. Indeed, pilots have to perform several cognitive tasks to handle spoken communications with the air traffic controllers:

- constantly listening to the VHF (Very High Frequency) radio in case their call signs (i.e. their aircraft's identifier) is called;
- understanding the controller message, even if pronounced with non-native accent and/or in noisy conditions;
- remembering complex and lengthy messages.

In short, industrial stakeholders consider today that ASR and NLU technologies could help decrease operators' work-

load, both on pilots and on controllers' sides. A first step towards cognitive assistance in ATC-related tasks could be a system able to (1) provide a reliable transcription of an ATC message; and (2) identify automatically the call sign of the recipient aircraft.

Although significant progress has been made recently in the field of ASR — see, for example, the work of [1] and [2] who have both claimed to have reached human parity in the switchboard corpus [3] — ATC communications still offer challenges to the ASR community; in particular because it combines several issues in speech recognition: accented speech, code-switching, bad audio quality, noisy environment, high speech rate and domain-specific language associated with a lack of voluminous datasets [4]. The Airbus Air Traffic Control Speech Recognition 2018 challenge was intended to provide the research community with an opportunity to address the specific issues of ATC speech recognition.

This paper is an attempt to provide an overview on the challenge outcomes. Section 2 presents the specificity of ATC speech as well as existing ATC speech corpora; section 3 describes the tasks, dataset and evaluation metrics used in the challenge; section 4 briefly describes the best performing systems and analyses the results of the challenge. Perspectives are discussed in section 5.

2. Specificity of ATC speech and existing ATC speech corpora

ATC communications being very specific, voluminous generic datasets like the SWITCHBOARD corpus [3] cannot be used to build an ATC speech recognition system. Table 1 provides a comparison of ATC speech vs. SWITCHBOARD speech. ATC speech provides many challenges to automatic speech recognition: audio quality is bad (VHF), the language is English but pronounced by non-native speakers, speech rate is higher than in CTS [5] and there is also a lot of code switching. The only advantage of ATC compared to CTS is that the vocabulary is limited to the International Civil Aviation Organization (ICAO) phraseology [6].

Several ATC datasets have been collected in the past. Unfortunately most of them are either unavailable, lack challenging features of ATC or lack proper annotation. On top of this, it was required that at least a small portion of the dataset had never been disclosed so that it could be used for evaluation.

The HIWIRE database [7] contains military ATC-related voice commands uttered by non-native speakers and recorded in artificial conditions. The mMTAC corpus [8] contains 24h of real-life, non-native military ATC messages. Unfortunately, it is

¹<http://www.malorca-project.de/>

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