Plane and simple: Exploration of machine interaction with text type for visual-based navigation systems

Oliver Austin

Abstract

Air travel provided the zoom for society before we had to 'Zoom'. However, at the most critical stage of flight, when the pilot and plane are coming to land, readability of runway designators is of utmost importance. While the methods of marking have traditionally been white paint on blacktop written in the standardized font used by the International Civil Aviation Organization (ICAO), with the aviation industry beginning to focus on the integration of fully autonomous systems into a variety of vehicles, it raises the question of whether the current font is suitable for visual-based navigational systems. This paper consequently examines the ability of machine learning software to read, learn, and recognize digits 0–9 and letters L, C, and R across a variety of fonts.

1 Introduction

On airport runways, there are a large variety of markers. In this paper, one group of these markers (i.e., Runway Designators) is examined to test their compatibility with autonomous aerial vehicles using Visual-Based Navigational Systems.

2 Runway designators

Runway Designators are a critical part of runway infrastructure. These markers, comprised of two numbers and in some cases, a letter, represent the three-digit magnetic heading of a runway and its relation to other runways at an airport. In order to simplify the three digits to two, the three digit magnetic heading is rounded to the nearest ten degrees of heading, and then the third digit is omitted. In the case that there is more than one runway at an airport all with the same heading, the characters L, C, and R are used to designate the Left, Center, and Right runways respectively.

3 Application of machine learning

In machine learning, there are three major steps that need to be taken to get an output, which can then be used by a system that has an integrated machine learning application. In the case of this project, the main focus is the use of a machine learning application in Visual-Based Navigation System for aircraft. Following are the major steps that need to be taken to achieve some form of output.

3.1 Collecting data sets

In this project, two different data sets were used, one comprised of images of the characters 0–9, L, C, and R in various fonts, referred to as the Multi-Font Data Set, and a second comprised completely of real-world pictures of runway designators, which are the same characters as the Multi-Font Data Set. Both of these sets were separated by character, which subsequently created the different classes used by the machine learning algorithm throughout the next steps.

3.2 Training the models

The next step in the process is to train the models using the previously obtained data sets. Each data set gets its own model file, which stores the patterns that a machine learning algorithm finds when sifting through the data. Each model is trained as a result of the machine learning algorithm passing through a data set a predetermined number of times (the quantitative unit for one pass being an epoch), looking for similarities between the individual pieces of data. Once training has been completed, or an increase of epochs fails to yield any more improvement, the findings are exported to the model file.

3.3 Interacting with new data

Once the model file has been exported, another machine learning algorithm can use the model to interact with new data. When applied, the algorithm is able to make predictions as to which class it thinks the new pieces of data should be put into, along with a confidence percentage specifying how similar the new data is to the patterns stored in the model. This information can then be used in many different ways to make informed decisions, such as whether or not an aircraft is lined up on the right runway.

4 Upcoming work

A second phase of this project will closely analyze the results obtained from the current data sets and discuss ways to improve them from both the design and computing standpoints.

5 Acknowledgements

Special thanks to Jennifer Claudio for helping see that the project stayed on track and seeing it through to where it is today, and Anthony Tieu, Kirsten Clemente, Aditi Jha, Arvin Singh, and Thu Thao Nguyen for helping with the preparation of data for the initial data set.

◇ Oliver Austin
San Jose, California, USA
hagridshome04 (at) gmail dot com

doi.org/10.47397/tb/42-2/tb131austin-plane