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Visual monitoring of landing gear in fighters using deep learning

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Abstract

The analysis of images using deep learning techniques makes it possible to detect anomalous or dangerous situations in different fields of application. This work aims to ensure the correct configuration of landing gear during aircraft landings. In contrast with other works, the small object detection problem is solved using background subtraction technique, and subsequently feeding it to our proposed convolutional neural network to automatically classify the position of the landing gear. This work also develops a new database that combines synthetic and real images, generated from exclusive fighter landing manoeuvres performed by a real test pilot. The obtained model, trained with synthetic data and tested with real images, presents a 0.9981 of accuracy. The result is a functional system, tested against real images and endowed with “early warning” capability as it is able to detect the position of an aircraft’s landing gear in advance and prevent catastrophic accidents.

Keywords Deep learning · Convolutional neural network (CNN) · Image classification · Landing gear detection · Artificial intelligence air forces

1 Introduction

Due to various circumstances, often related to human error, an aircraft may land without fully extending its landing gear. This event is known as a “belly landing”, as the aircraft uses its underside or “belly” to land. For this reason, currently, at the Spanish Air Force Academy (SAFA), a visual inspection is carried out from the control tower to check the position of the landing gear of the aircraft approaching for landing. This task is performed by a second lieutenant student (4th year cadet) using binoculars, and it is critical to ensuring flight safety. However, this method is not infallible, as fatigue is an unavoidable factor that can lead to human error.

This paper proposes a new system designed to automatically identify and classify the position of the landing gear using image analysis, with good results replacing the human observer in the control tower. Thanks to the use of deep learning (DL) techniques to computer vision (CV) [11], the system effectively detects improper landing gear configurations, as demonstrated in Fig. 1. Although the initial focus of this system is on the Spanish Air Force, it could also be applied to civilian airports or aerodromes that

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