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Identifying High Velocity Objects in Complex Natural Environments Using Neural Networks

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Abstract

Real-time tracking of highly dynamic and complex objects has been an important aspect of testing in the aerospace industry for several decades. This paper proposes a methodology to identify complex, high velocity targets of interest in a video stream. The targets used in this case are aircrew escape systems, ejection seats, as they are propelled from a dynamic aircraft test bed. Additionally, the testing environment is cluttered with natural and man-made artifacts that affect the background appearance and make the video stream data visually noisy. The object identification problem involves the extraction of critical information from the video stream and feeding it into a neural network that determines the position of the target of interest within the field of view. The results of the computer simulation and analysis were mixed, and show that the proposed methodology is a potentially viable solution but will require continued development.

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1. Introduction

Since the advent of modern jet powered flight, crew safety has been of significant importance. Crew escape technology has progressed from simple parachutes to highly sophisticated escape pods capable of negotiating harsh environmental extremes to safely return pilots and crews to the ground from crippled aircraft. The US Dept. of Defense spends significant time and effort testing crew escape systems to ensure that the crews of modern military aircraft have significant probability of survival should the need arise.

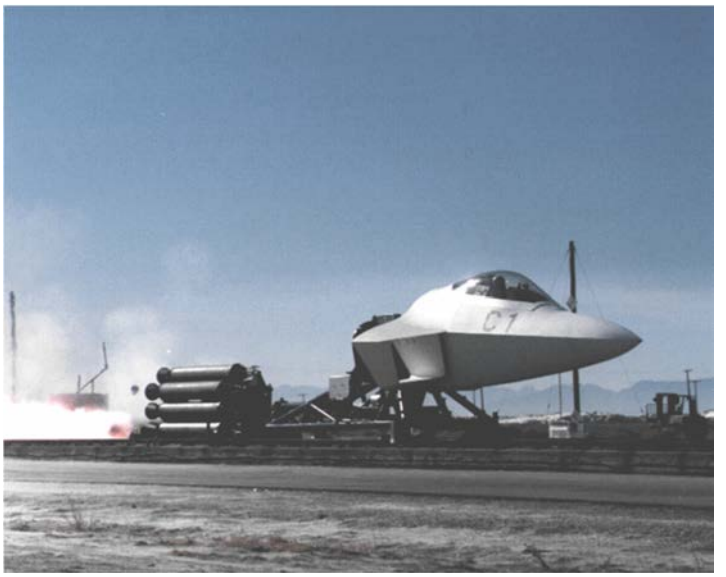

Figure 1: Rocket Sled Test Bed

The US Dept. of Defense performs demonstration testing on crew escape systems in near realistic conditions. High speed test facilities, such as the Holloman High Speed Test Track [1], use rocket-powered sleds to accelerate test articles to velocities that simulate flight conditions. Crew escape systems have been tested at sled velocities ranging from 0 ft/sec to over 1000 ft/sec [2]. Video data collected during the tests is used for performance analysis and validation of crew escape systems.

The inherent complexity of the items under test and the test environment can make object identification within the video stream difficult. The object of interest changes as the test progresses. Initially, the object of interest is the rocket sled itself as the test bed is accelerated to test velocities. When the sled has achieved the proper test conditions, the object of interest changes to the crew escape system. The crew escape system is the object of interest as it transitions from being a component of the sled test bed to a dispensed dynamic projectile. The object of interest changes again as the crew escape system splits into two objects, the ejection seat itself and the manikin that represents the human in the system.

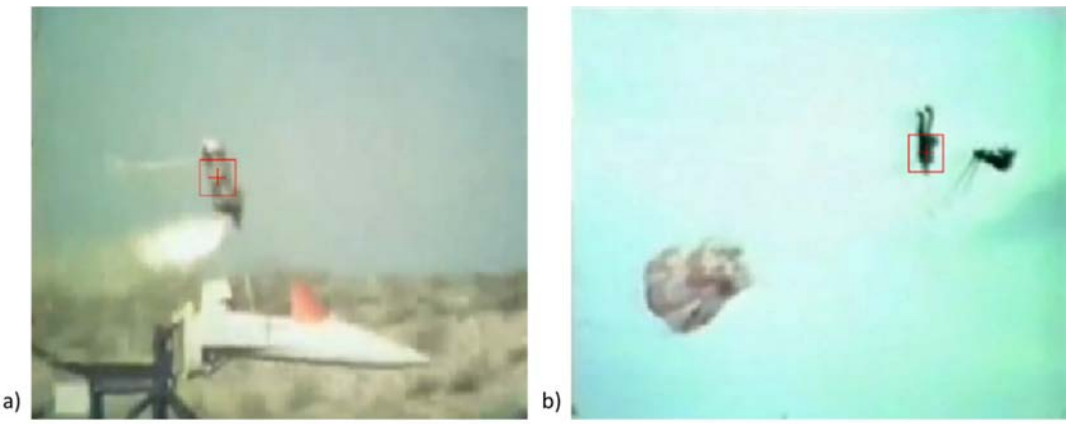

Figure 2: Object of Interest at different test phases a) sled / crew escape system separation b) manikin / seat separation

The test environment is also very complex as it is comprised of natural and man-made artifacts that may disguise or