MODELLING THE PERFORMANCE OF AN AIRBORNE FORWARD-LOOKING INFRARED SYSTEM IN THE AUSTRALIAN ENVIRONMENT

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Abstract: Prediction of the operational performance of a forward-looking infrared (FLIR) system requires a computer model accounting for the principal variables affecting classification range. The range performance is degraded by many factors, including sensor resolution, atmospheric attenuation, platform vibration and visual display information. The Tenix FLIR_P Performance Model was developed to estimate the classification range of an electro-optic sensor, and provides comparative performance estimates for different system configurations and operational conditions. Results are presented for classification range prediction and its variation with absolute humidity in the 3-5 μm infrared band as used in some airborne thermal imaging systems.

INTRODUCTION

One measure of system performance for an airborne electro-optical sensor is the classification range (that is, the maximum range for target recognition). The forward looking infrared (FLIR) sensor mounted on the upgraded S-70B-2 maritime helicopter is affected by such variables as the field-of-view, infrared atmospheric transmittance, object size and intensity, and line-of-site (LOS) stabilisation. Figure 1 shows an example of a FLIR image of a ship taken from a low-flying helicopter. Contrast has been enhanced by dynamic range expansion resulting from increasing the range in the grey-level histogram. In the S-70B-2 helicopter the FLIR system is located under the nose cone and controlled from within the cockpit.

Prediction of classification range from computer modelling enables cost-effective comparisons of various system configurations and, in particular, the assessment of visual display size, viewing distance, vibration or jitter, atmospheric conditions and observer/eye optical performance variations [1-3].

FLIR PERFORMANCE MODEL

A single field trial is a spot measurement taken under a unique set of conditions. The question arises as to how typical and how reproducible are the results from a single field trial? Transmittance can vary hourly and daily. In a sea trial, parallel lines-of-sight separated by only a few hundred metres can be subject to different meteorological conditions [2]. Computer modelling can be used to explore a matrix of scenarios and test the operational envelope, with perhaps many hundreds of different experiments. Modelling is very cost-effective compared with flight trials and supports comparative performance studies to evaluate system design changes. It can be used to estimate performance under a range of conditions and facilitates "what if?" analysis. The computer model used should conform to internationally accepted methodology or performance frameworks, such as the US Defence FLIR92 standard [2].

The main applications of the Tenix *FLIR_P* Model are (a) prediction of classification range of a FLIR system or thermal imager and (b) provision of performance comparisons for a variety of system configurations and environmental conditions. It is consistent with FLIR92 and NVTHERM framework used by US Defense Department [3].

The Tenix *FLIR_P* Model first converts laboratory MRT measurements (minimum resolvable temperature difference between object and background) to MRT in the aircraft environment and then computes FLIR classification range (Figure 2). The MRT values in the aircraft environment have been 'degraded' by atmospheric and system variables, such as the effect of atmospheric absorption and scattering on IR transmittance.

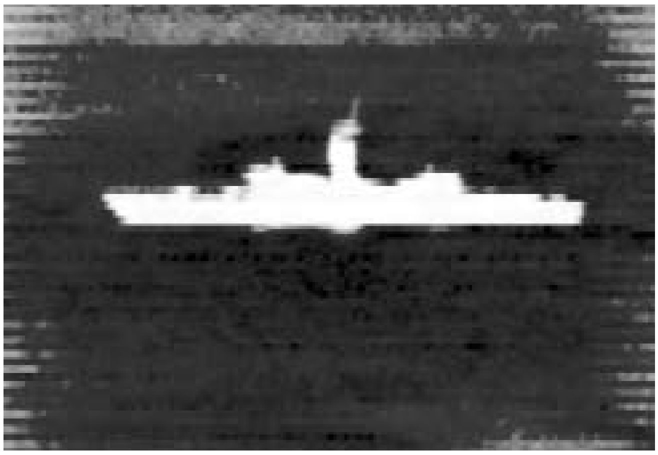

Figure 1. Image of a ship taken from an airborne FLIR system.

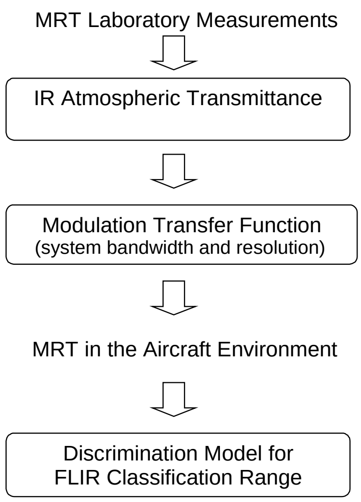

Figure 2. Flow chart for Tenix *FLIR_P* Model.

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1440-5113