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Investigation of Environmental Effects on IR Signature Simulations and the Detection Performance of Different Seeker-Head Models.

ABSTRACT - Masterthesis

In military aviation aircrafts are faced with a lot of different threats, which are already initiated by the detection of the aircraft. The detection primarily depends on the aircraft's signature characteristics in the sensor's spectral range. Apart from the prominent radar cross section, the signature consists of the acoustic, optical and infrared (IR) radiation behavior. The infra-red radiation is determined by temperatures, materials and surface conditions of the aircraft and very importantly by the atmospheric and environmental effects.

The thesis deals with the integration of the commercial IR scene simulation tool MuSES by ThermoAnalytics Inc. into the IR signature evaluation process. The software considers several user definable weather and environmental effects within the ray tracing- based IR image rendering. Moreover, the IR signature model is fundamentally extended compared to former models by using CFD (Computational Fluid Dynamics) simulation results in the form of sur-face temperatures and plume data. As part of this thesis a huge data processing and structuring process is developed in order to use the CFD input in the software.

Previously, the consideration of environmental effects was not part of the IR signature evaluation. Therefore, the influence of sun and earth radiation, humidity, cloud coverage, rain rate and atmospheric transmission on the IRSL (infrared signature level) being a key value in IR analyses is investigated. The investigation shows that the different environmental parameter alterations have a significant impact on the IRSL in the three major wavelength bands (SWIR, MWIR and LWIR).

Furthermore, in this thesis the lock-on range of seeker head models from the first to the third generation is analyzed to identify the impact on their detection performance. The comparison between simulations with and without environmental influences shows large differences concerning the calculated lock-on ranges.