Novel Track-before-Detect with Neural Networks

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***Abstract*—An integrated Track-before-Detect neural network is described leveraging existing computer vision technology in order to combat challenges posed by traditional CFAR-based detection systems. By separating the tracker and detector into a separate feedback loop allowing for dynamic detection thresholds, novel results were obtained.**

Keywords—track before detect, radar, drone, machine learning, neural networks

I. Introduction

While the principal aim of a radar system is to detect objects, the problem of declaring a target from received waveforms persists. One manner of distinguishing between a real detection and noise is called Track-before-Detect. Here, a tracker locks on to moving objects in real-time without attempting to classify them. The detector, which is computationally expensive, then attempts to classify designated tracks to confirm whether a real target is present. Track-before-Detect allows a firm way to distinguish between blips in a radar's received waveforms and true objects. In time-sensitive cases such air missile defense or drone strikes, real-time classification of traditionally noisy objects is imperative.

Historic Track-before-Detect systems do have a major fault, however. One of the cornerstones of DSP-based implementations is the determination of a CFAR- constant false alarm rate. It is an empirically hard problem to determine a static threshold as having one too low will raise false alarms to the detector and one too high will never yield a target declaration.

This paper will implement a Track-before-Detect system employing neural networks in order to offer a dynamic solution to the CFAR problem. By constructing the tracker and detector out of separate machine learning networks with a feedback pipeline in between, a fluid answer to tripping the detector from verified tracks arises.

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