

ON-BOARD DEEP LEARNING FOR PAYLOAD DATA PROCESSING: HARDWARE PERFORMANCE COMPARISON

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ABSTRACT

The path towards a multi-planetary species passes through the implementation of disruptive technological innovation. Artificial Intelligence and autonomy on spacecraft will be a fundamental part of this future. Hence, leveraging on-the-edge AI accelerators, such as FPGAs, GPUs, VPUs, ASICs, will constitute an essential component of the spacecraft hardware of tomorrow.

This work presents a comparative work, specifically targeted to the use of on-board satellites.

The tested platforms are Intel Myriad X, Nvidia Jetson Nano, and CPU (x64 architecture)

PLATFORMS

Intel Myriad is a dedicated hardware accelerator for deep Neural Network inferences also known as the Visual Processing Unit (VPU).

Jetson Nano is the Nvidia solution for low-powered high-performance devices. It is a System on Module (SOM) based on ARM with an NVIDIA GPU.

DATASET

As dataset to experiment on we used the **SPEED**, provided by ESA ACT and Stanford University.

The dataset is composed by **12000 grayscale images** at full HD resolution (1920 x 1080).

TASKS AND RESULTS

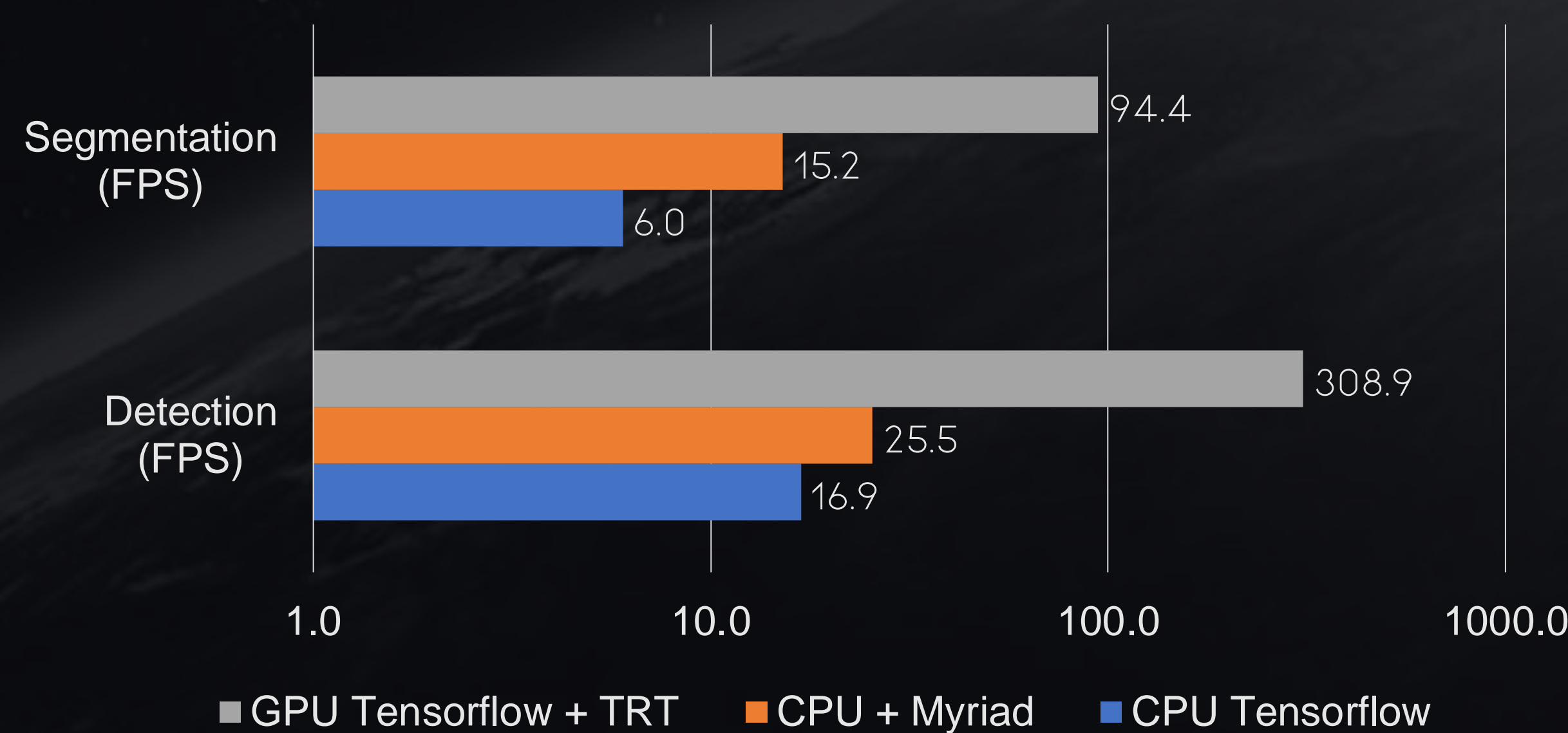
A **detection algorithm** is able to locate the position of an object in an image and classify the type of object, in this case the task is quite simple, because we have a single object to classify and localize.

The **segmentation task** is slightly more complex. The objective of this model is a pixelwise classification of the image. The output is a mask in which each pixel represents the probability to belong to a particular class.

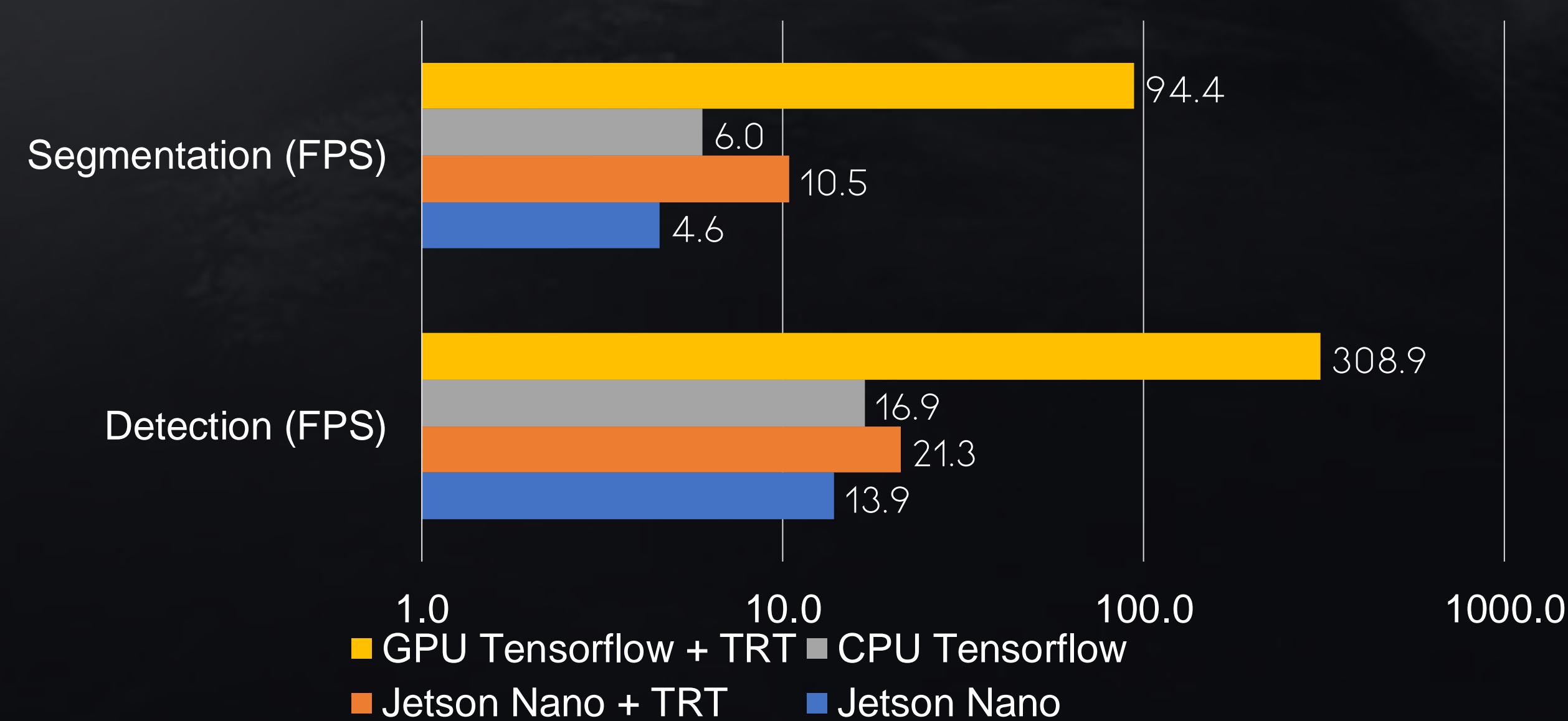
Myriad is performing well in general and is widely adopted. It is also one of the most energy efficient accelerator for AI.

Jetson Nano on the other side is interesting because integrates a full system ready to be deployed on custom hardware. The training mode onboard opens new horizons for the future.

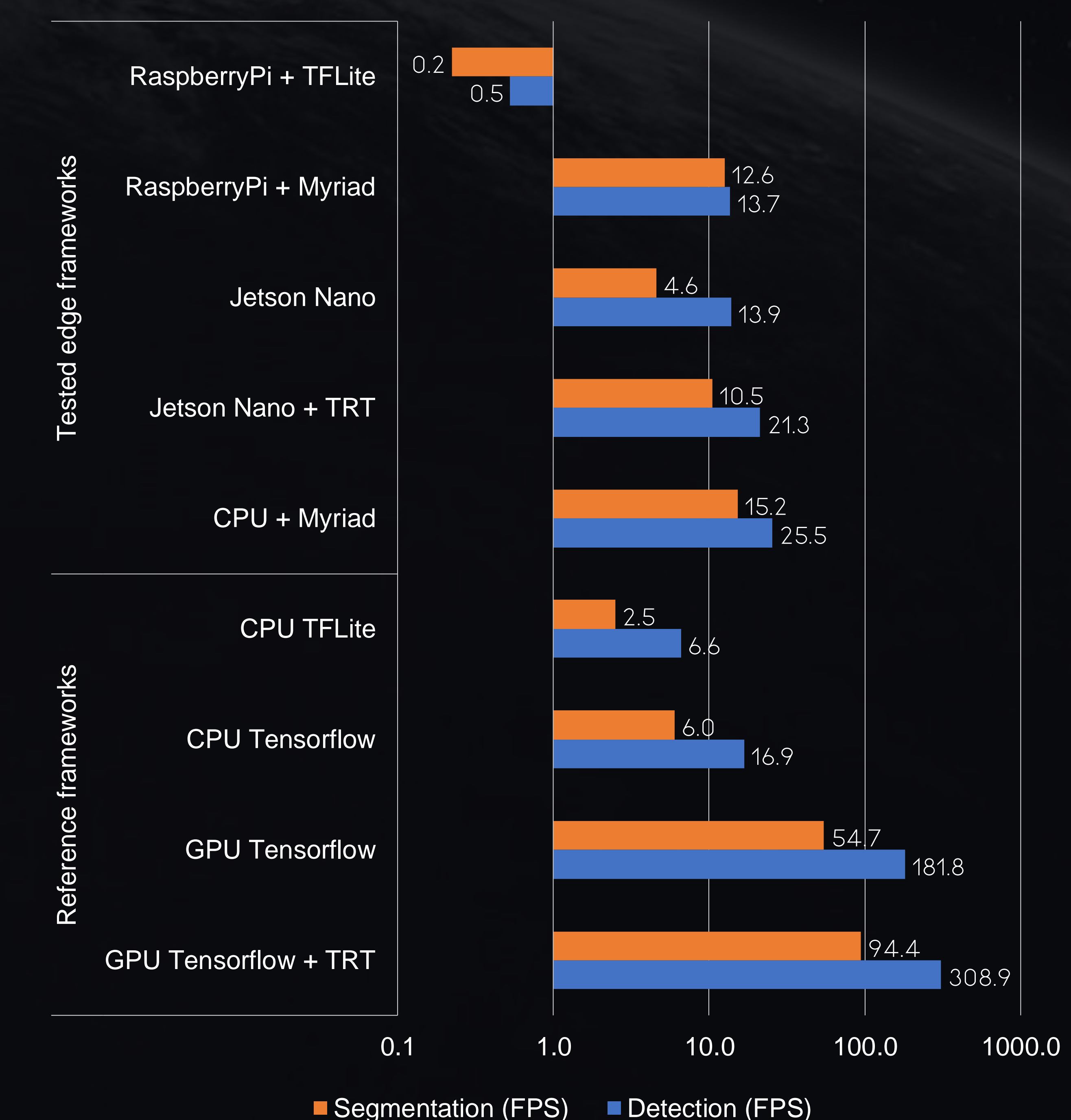
MYRIAD X VS CPU VS GPU (FPS)¹



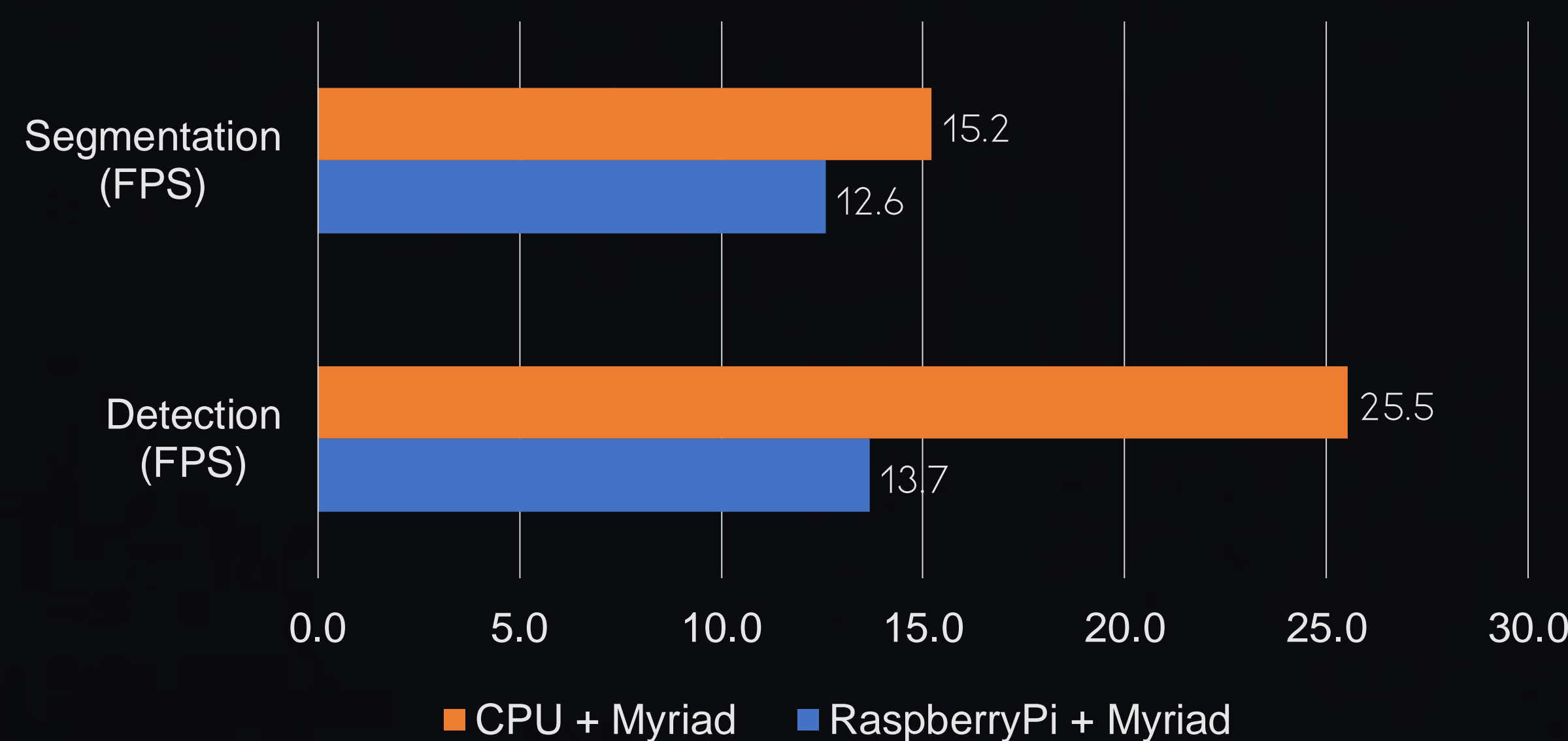
JETSON NANO V. CPU V.GPU (FPS)¹



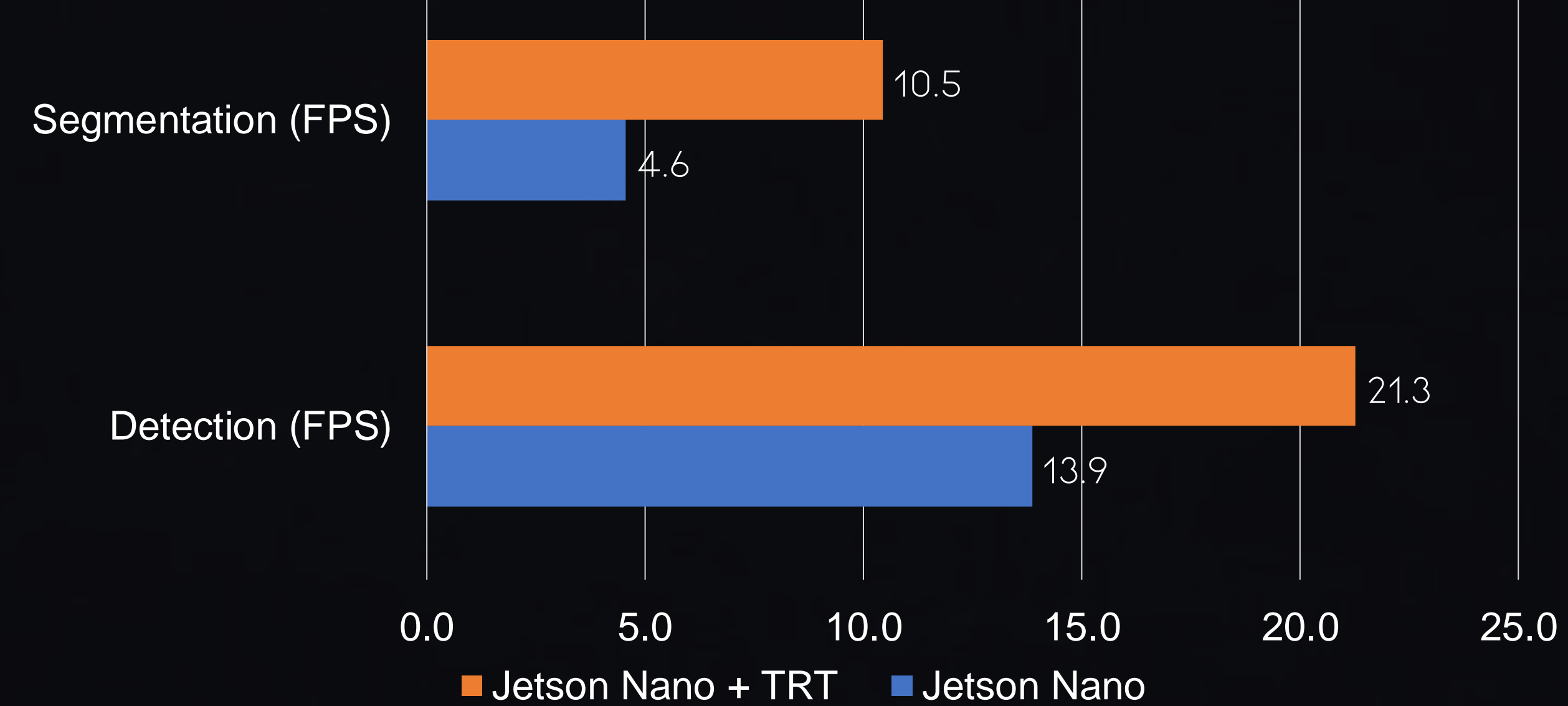
OVERALL COMPARISON (FPS)¹



MYRIAD X PERFORMANCES ON CPU AND RPI (FPS)¹



JETSON TRT ACCELERATION (FPS)¹



¹ Higher is better