Problem Statement

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Abstract

This project aims to create a system that uses multiple cameras to combine their respective images in real time to provide a near-real-time composite video feed. In order to complete this project, my group and I will have to learn certain computational techniques including parallel programming, image-processing operations, intermediate-level operations, and matrix-vector operations. The project will use Nvidia Jetson TX2 modules to perform the computations on the video signals. This module will provide us with the processing power we need to perform the necessary computations on our video feeds.

Problem Definition

The problem we are attempting to solve is to combine multiple images from different cameras into one image, using multiple cameras that operate on different spectral bands including visible light, infrared, and others.

Our first iteration of the project will be able to use two cameras to achieve this, but the end goal is to be able to use six cameras. At this point we will use multiple spectral bands and create composite images using all six cameras.

Proposed Solution

Our solution will use the Nvidia Jetson TX2 system to interface with the cameras and perform the computations that allow us to create the composite images. The TX2 is an embedded computing device; it's described as a 7.5-Watt supercomputer on a module and includes 8GB of memory and 59.7 GB/s of memory bandwidth.

The TX2 has enough processing power to run AI and deep learning algorithms so it should be enough to perform near-real-time video processing. Once we have a system that is able to process video feeds from multiple cameras, we will use the video feed data from each camera to create composite images in near-real-time. Then, once we have a system that can create these real-time composite video feeds, we will attach it to a drone and relay a real-time video feed to us.

Performance Metrics

Our project will have satisfactorily met the requirements when it is able to use two cameras connected to the TX2 to create a composite image. It must also meet SWaP-C requirements in order to be able to be used on drones.

The proposed system requires that the TX2 finish image processing and computation of one frame's images before the next frame is captured. If a video is captured at f frames per second, then each computation must be done in τ seconds, given

$$f = \frac{1}{\tau}$$

As for SWaP-C, the entire system must be lightweight and resilient to vibration, altitude, extreme temperatures, and probably some moisture. The system will eventually be mounted on a drone so it must also be small enough to do so.