

Article Overview

An optical flow module estimates velocity by analyzing the apparent motion of features in sequential images captured by a downward-facing camera, often combined with a distance sensor to convert angular motion into linear velocity.

Core Principle

Optical flow modules operate by detecting motion in the visual field. A downward-facing camera captures consecutive images of the surface below. The module tracks the displacement of visual features (such as texture patterns or particles) between frames. This displacement, measured in pixels, represents the angular motion of the image relative to the sensor's body axes. Forward movement causes rotation of the ground image about the Y axis, while lateral movement causes rotation about the X axis, due to the camera's perspective .

Integration with Distance Measurement

To convert angular motion into linear velocity, optical flow modules often use a distance sensor, such as LiDAR or ultrasonic sensors. The distance from the sensor to the ground allows the system to scale the angular displacement into real-world speed, enabling accurate velocity estimation even in GNSS-denied environments like indoors or underground .

Data Processing and Output

The optical flow sensor outputs angular measurements in radians, which are then fused with other velocity data sources in the flight controller or navigation system. The sensor communicates via protocols like MAVLink or I2C, publishing messages such as `OPTICAL_FLOW_RAD` for angular flow and `DISTANCE_SENSOR` for altitude. These data streams are used to maintain position, stabilize flight, or navigate autonomously .

Alternative Optical Flow Techniques

In industrial applications, optical flow can also be measured using Laser-Two-Focus (L2F) technology. Here, two laser beams detect light-scattering particles in a fluid. The time delay between pulses generated as particles pass through the beams is inversely proportional to particle velocity, analogous to measuring vehicle speed between two marks on a road . While this is more common in fluid flow measurement, the principle of detecting motion via sequential optical signals is conceptually similar.

Summary

Working principle of optical flow module

An optical flow module combines image capture, feature tracking, and distance measurement to estimate velocity. By analyzing the apparent motion of the ground or particles, it provides real-time velocity data for navigation, stabilization, and control in environments where GPS is unavailable, making it essential for drones, robotics, and industrial flow monitoring .

Unlock the secrets of optical flow in computer vision. Learn the fundamentals, algorithms, and applications of this

As an important part of fiber-optic communication, an optical module is a photoelectric converter which converts electrical signals into

Consider in the train example, how objects near the observer will move faster across an image than ones in the background. This

Optical Flow Equation Brightness constancy equation $I_x + v I_t = 0$ What do static image gradients have to do with motion estimation?

Discover optical flow sensors for precise drone positioning. Learn how these vision-based

Explore the essential principles and types of optical modules for fiber optic communication systems.

David J. Fleet, Yair Weiss **ABSTRACT** This chapter provides a tutorial introduction to gradient-based optical flow estimation. We

Very often when working with video streams, it's necessary to characterize and quantify the motions of the objects

Explore the working principles, structures, and performance metrics of optical modules, essential components of

48 Optical Flow Estimation 48.1 Introduction Now that we have seen how a moving three-dimensional (3D) scene (or camera)

Optical Flow Sensors (landingpage) Copter, Plane and Rover support Optical Flow Sensors. These are camera modules that use

Working Principle of Optical Modules Optical Modules (also known as Optical Transceivers) are critical components in fiber optic

Working principle of optical flow module

The function of the optical module is to carry out the photoelectric and electro-optic conversion. The transmitter

Optical Flow uses a downward facing camera and a downward facing distance sensor for velocity estimation. It can be used to

Understanding the working principle of optical modules--especially SFP transceivers--is critical for network

Optical flow tracks how objects move between video frames. Here's how it works, how your brain does it naturally,

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