Real-Time Multi-Resolution FAST Delaunay-Based Video Compression for Low-Latency Teleoperation over Low-Bandwidth Connections

Computer Vision Project Proposal

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Recent years have seen an explosion in low latency teleoperation of UAV’s and UGV’s in hobbyist, law enforcement, and emerging commercial markets. Availability of low cost, lightweight and high performance lithium batteries, brushless DC motors, structural materials such as (EPO foam and carbon fiber), computing & sensing platforms, and cameras have made entire teleoperation systems capable of operating wirelessly within a 1 mile range using commercial off-the-shelf components possible for well under $500. One of the greatest limiting factors in such systems is the transmission of video data, with most “first person view” (fpv) systems relying on low resolution and noise prone analog video transmission.

In this project will make the assumption that the most valuable portions of video for a remote operator of a relatively high speed dynamic vehicle are consistent areas of high contrast such as corners and edges. The goal is to implement and integrate various feature detection algorithms such as FAST, and the Hough Transform in order to identify straight line edges of high motion importance. The compression will be similar to modern video compression such as MPEG, except stable portions of the image will be largely ignored all together. Instead of the compressed video stream consisting of pixel values, it will consist of sets of colored polygon vertices that bound regions of high interest and represent the average contained color. Delaunay Triangulation is anticipated to aid greatly in quickly subdividing the image in a pseudo motion segmentation scheme at very high speed, even when implemented in software. This reduced geometric video stream can then be sent over low cost, long range wireless serial modems such as the XBee radios. Since in practice most “fpv” operation usually consists of onboard recording of high quality video while remotely viewing a substantially lower quality but high frame rate/low latency video feed, the proposed solution could offer very large gains in vehicle mobility and range.