Real-Time Vector Geometry 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, military, law enforcement, and emerging commercial markets. Availability of low cost, lightweight, easy to use, and high performance power systems, structural materials, 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 $1000. One of the greatest limiting factors in the usefulness of such systems is the live transmission of quality video data, with most “first person view” (fpv) systems relying on low resolution and noise prone analog video transmission.

This project will make the assumption that the most valuable visual information for a remote operator of a relatively high speed dynamic vehicle consists of moving features 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 segments of high motion importance. The compression will operate somewhat similarly to modern video compression such as MPEG. Instead of the compressed video stream representing spatial-temporal pixel color groupings, it will consist of polygon vertex lists that bound regions of high interest and represent the average contained color.

The challenge is to quickly subdivide the image in a pseudo motion segmentation scheme at 15-30 frames per second even when implemented in software, while reducing the amount of needed information to a level that can then be sent over low cost, long range wireless serial modems such as XBee radios. The proposed solution could offer very large gains in vehicle mobility and range by lowering one of the capital costs, allowing richer content to reach the operator over existing transmission systems, and enable the use of lower cost direct transmission systems for lower latency.