Visual Annotation of Landmarks for Vitreoretinal Surgery

Computer Integrated Surgery II
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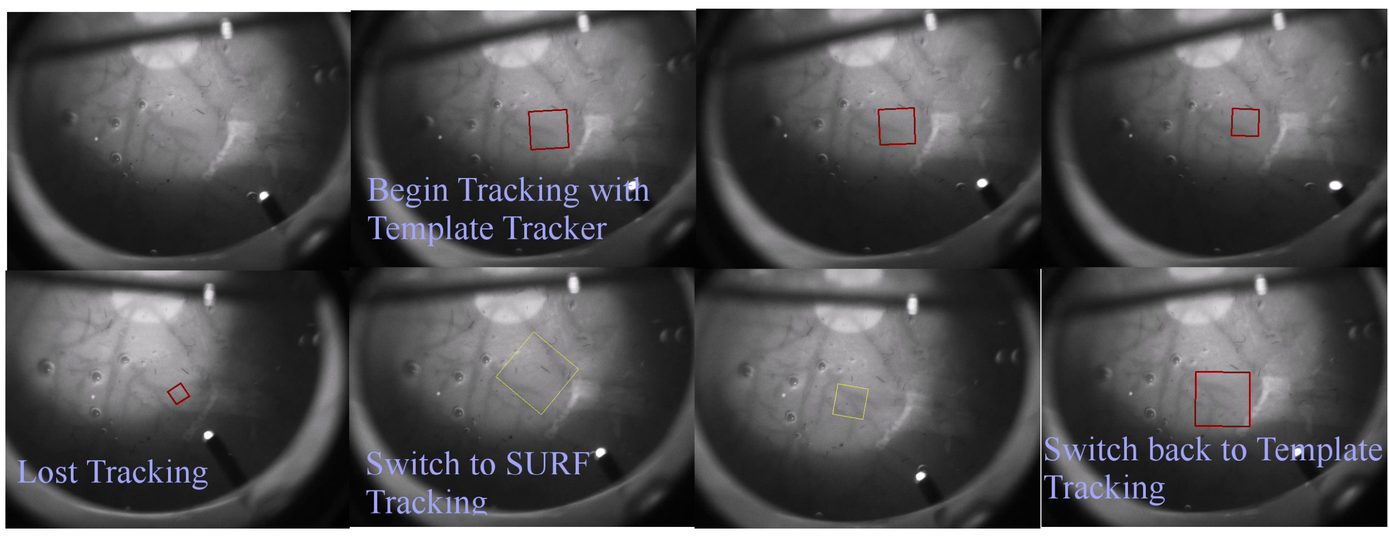
Introduction

- Provides registration between pre-operative and intra-operative images using feature detection and matching to create a transformation
- Allows for tracking of specific landmarks in a video feed from a source image
- Uses OpenCV Library and CISST framework, and integrates with existing projects (Fast Template Tracker)



Mockup of how this Template Tracker and SURF Tracker works with each other

The Problem

- Pre-operative fundus scans of the retina is obtained. Surgeons annotate specific spots that they want to look at during surgery
- During vitreoretinal surgery, surgeons look through a microscope while manipulating tools with their hands.
- Surgeon has limited mobility of tools in retina, and has to mentally keep track of what they do inside the retina
- Programs can help to relieve surgeons' mental load by detecting and highlighting the previously annotated points on the video feed

The Solution

- Overlay important points so that surgeon can be aware of them when panning around the retina
- Combine (slow) SURF tracker with (fast, but imprecise) Template Tracker(existing solution implemented by Rogerio Richa)

Initialize
- Detect Features on initial image to track using SURF (Speeded-up Robust Features)

Detect
- Detect features on Live Video Feed using SURF

Match Features
- Determine matches between features using NCC (Normalized Cross Correlation)

Compute Transformation
- Compute 3-Degrees of Freedom (DOF) transformation model from matches

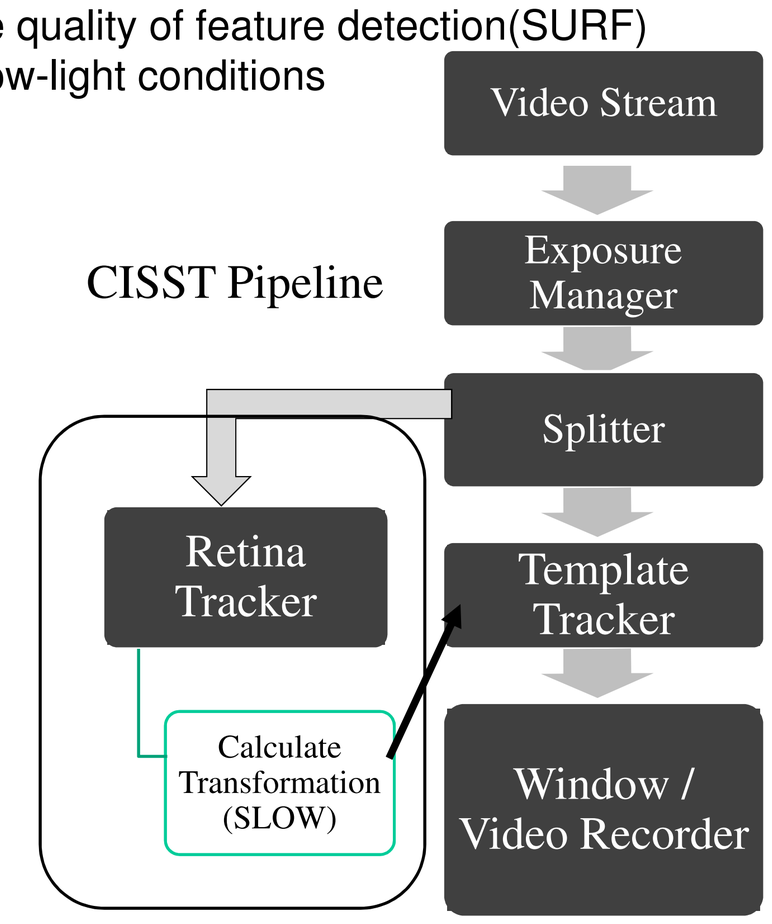
Overlay
- Overlay transformed point on live display
- Pass Transformation to other CISST filters to use

Outcomes and Results

- Each transformation calculation takes 200-500ms
- Valid transformation(transformation grid conforms with expected rotation, scale and movement) every 4-10 calculations
- Ability to switch between SURF Tracker and Template Tracker based on confidence level of transformation

Future Work

- Improve on the speed of algorithm
- Image processing on video feed to aid in feature detection
- Improve quality of feature detection(SURF) under low-light conditions



Lessons Learned

- Designing a process to fit within an existing object (CISST framework) may be difficult since the other object may be too rigid to change or difficult to debug

Support by and Acknowledgements

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