Automated Surgical Video Artifact Identification

Zion Chang | Sidney Lu | Jing Bian | Tony Korol | Will Peng

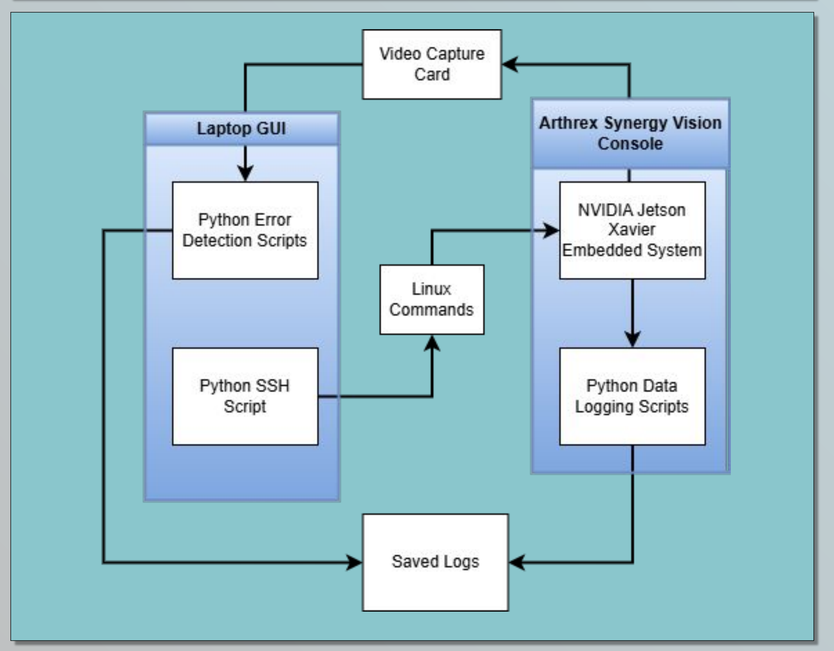
Background

Arthrex designs minimally invasive surgical cameras that allow surgeons to extend their vision into the human body. Arthrex devices rarely experience video anomalies, but even rare interruptions to video footage can be fatal. Manually searching for errors in video footage is very tedious. AccuScope automatically detects, classifies, and characterizes errors found “in the field” and during testing.

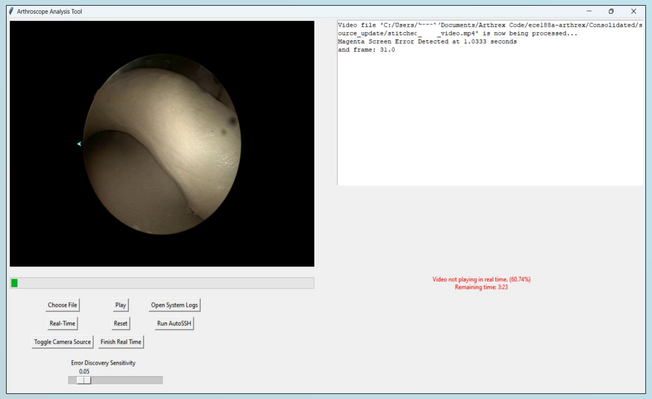
Goal: Develop a suite of tools that can be used to automatically analyze video footage and identify issues, without the need for human intervention.

- Back-end: Python-based computer vision algorithms analyze and identify issues in video
- Front-end: Intuitive graphical user interface integrates error detection, system monitoring, and result generation

Software Block Diagram



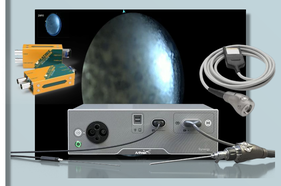
AccuScope Overview



- User-Friendly Test Tool Suite: live playback window, live text display, video processing settings, and status labels
- Full integration with Arthrex Synergy Vision™ hardware through SSH connection
- Automatic text, graphical, and video error logging

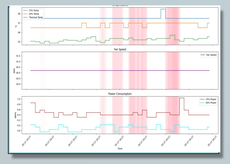
Key Components

Post Processing
Upload any saved surgical video and generate a concise error summary with both video and text logs



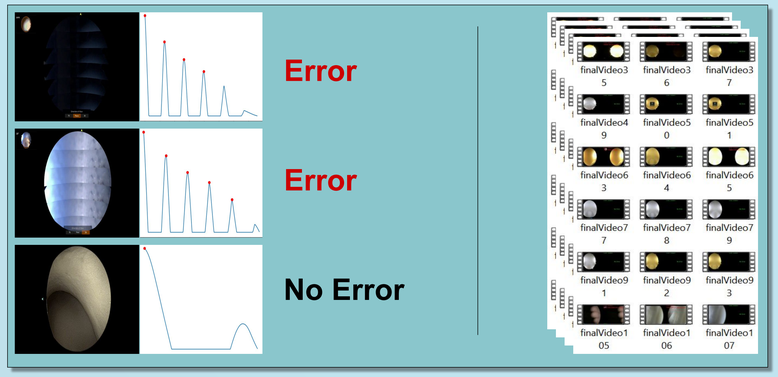
Real-Time Processing
Streamlined SSH and HDMI connection for automated real-time error detection and classification. Results include video, text, and graph error logs

Error Discovery
Novel, highly optimized error detection algorithms perform efficient and instantaneous detection of both known and previously unknown errors



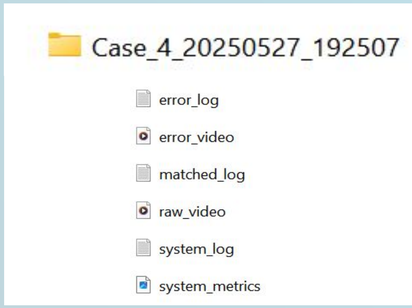
Error and System Status Logging
Log exact time of error in real-time with SSH to highlight potential anomalies in system hardware at the time of error

Robust Real-Time Classification



- (Left) Feature extraction Algorithm shows robustness to scene variation and a distinct decision boundary for Pano-70 errors
- (Right) Hundreds of successful real-time error detection trials with live footage prove that our algorithms work efficiently and correctly
- Classical Image Processing, Signal Processing, and Statistical methods implemented to classify errors.

Intuitive System and Error Logs



- A new case file is automatically generated each time a test engineer uses the AccuScope application
- Each case includes video error playback, system logs, and error density indication on error log plot

Acknowledgements:
UCSB: Ilan Ben-Yaacov, Ethan Freifeld
Arthrex: Zachary Dominguez, John Batikian, Nystha Baishya, Jason Metzner, Wyatt Spivak