INTRODUCTION

• Face is the main focus in selfie videos, live show or vlogging.
• Traditional EIS only stabilizes background, and leaves face unstabilized.
• Steadiface simultaneously stabilizes both the face motion and background.
• Steadiface is the first real-time, what you see is what you get front camera stabilization solution on mobile devices.

CHALLENGES

• Face motion is complex (pose and expressions) with many corner cases (illumination, occlusions, entering/leaving scene, etc.).
• Face and background smoothness need to be combined and balanced.
• Tight time/power budget: realtime on mobile devices.

SOLUTION

FACE-GYRO COMBINED STABILIZATION

• 2D facial landmarks and 3D head pose are extracted from the input video frame.
• Smooth 2D face center is then estimated from the 2D facial landmarks.
• Camera rotation is calculated from the gyro data.
• A virtual camera pose is then optimized so that the stabilized face is located at the estimated face center, and virtual camera rotation changes smoothly.

OPTIMIZATION WITH A UNIFIED FACE-BACKGROUND STABILITY METRIC

• Face stability is measured the deviation of stabilized face center from the target head center, and background stability is measured by how smooth the virtual camera pose changes across frames.
• The two metrics (and some other terms) are combined into one single objective function, and solved by nonlinear optimization.

\[
\text{argmin}_{\omega_1, \omega_2} E_1(P_t) + \omega_1 E_2(r_t) + \omega_2 E_3(r_t) + \omega_3 E_4(t) + \omega_4 E_5(P_t). 
\]

DYNAMIC OPTIMIZATION TERM WEIGHT ADJUSTMENTS

The weights of each term are dynamically adjusted based on the 3D head pose, gyro motion and landmark confidence so that
• Virtual camera does not move when head is purely rotating or the camera is stable (e.g. on a tripod).
• Virtual camera does not jump around when landmarks are inaccurate due to random occlusions or extreme head poses.

CONCLUSIONS WITH THE STATE-OF-THE-ART

• V.s. gyro-based fused video stabilization on Google Pixel 3.
• V.s. Selfie video stabilization by Yu and Ramamoorthi.

RESULTS

COMPARISONS WITH THE STATE-OF-THE-ART