Detecting Moving Objects in Aerial Imagery captured from Unmanned Aerial Vehicle (UAV)

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Unmanned Aerial Vehicles

- Extends human reach
- Can be programmed to complete the mission autonomously
- Large area covered
- High resolution images at varying altitudes
- Multi modal imagery – Thermal and Visible
- Clear Aerial overview
- Discrete and Silent – Low noise levels as opposed to helicopters
- Low Cost

UAVs and computer vision

- Surveillance – Security and Defence Systems
- Traffic Analysis
- Wildlife Monitoring
- Disaster Response
- Search and Rescue
- Path Planning, Navigation Control

- Maybe Amazon delivery!

SURVEILLANCE AND TRAFFIC MONITORING

- Reconnaissance, Tactical and Security applications
- Border patrol
- Compute traffic metrics automatically
- Detect unusual activities
- Dutch Government deploys drones to get real time traffic information on route to Concert at Sea festival in Zeeland
- Drones deployed on Mumbai-Pune expressway to monitor traffic and the cause for accidents

WILDLIFE MONITORING

- Wildlife Monitoring, Population Estimate
  - Namibia Kuzikus Wildlife Reserve
  - Shark patrol
- Detecting wildlife in agricultural land
- Low noise, does not disturb the animals
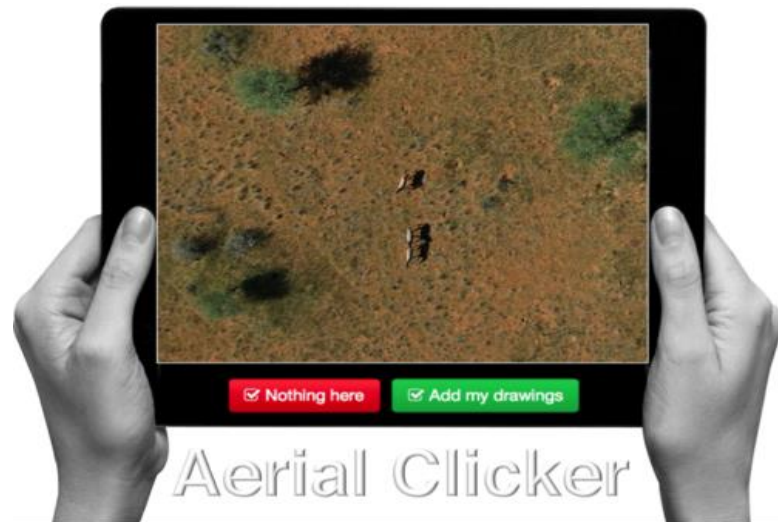
MOVING OBJECT DETECTION

- Detect moving foreground
- Track them over next few frames

THE FOREGROUND DETECTION PROBLEM

- Global Vs. Local motion(UCF dataset - Actions sample)

CHALLENGES

- Constantly moving background
- Altitude and perspective variations
- Camera jitter
- Changing weather conditions

Methods for Estimating Global movement
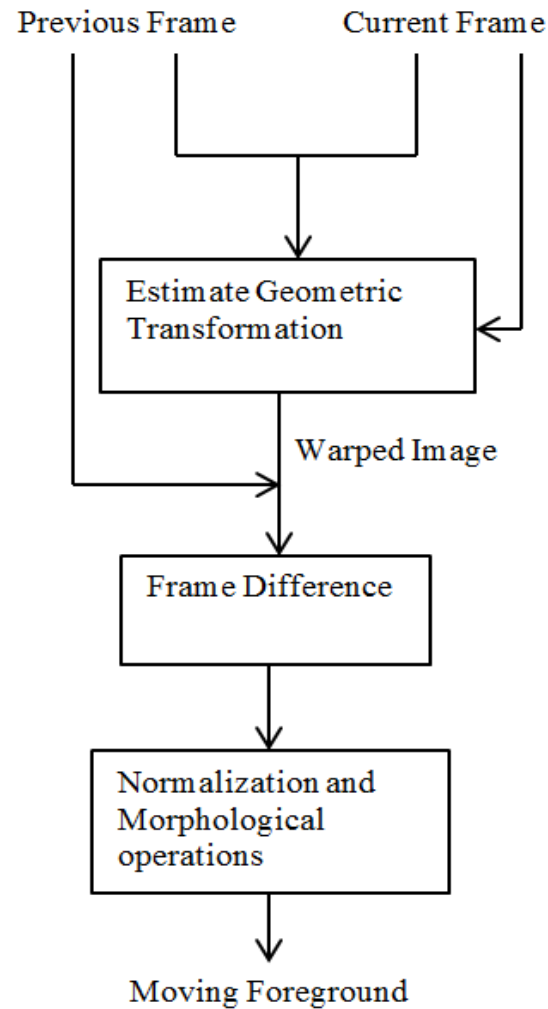
- KLT points tracker
- Optical flow
- Moments

ORIGINAL VIDEO – UAV123 DATASET

Matthias Mueller, Neil Smith and Bernard Ghanem, **"A Benchmark and Simulator for UAV Tracking"**, European Conference on Computer Vision (ECCV 2016)

APPROACH USED

Previous Frame   Current Frame

Estimate Geometric Transformation

Warped Image

Frame Difference

Normalization and Morphological operations
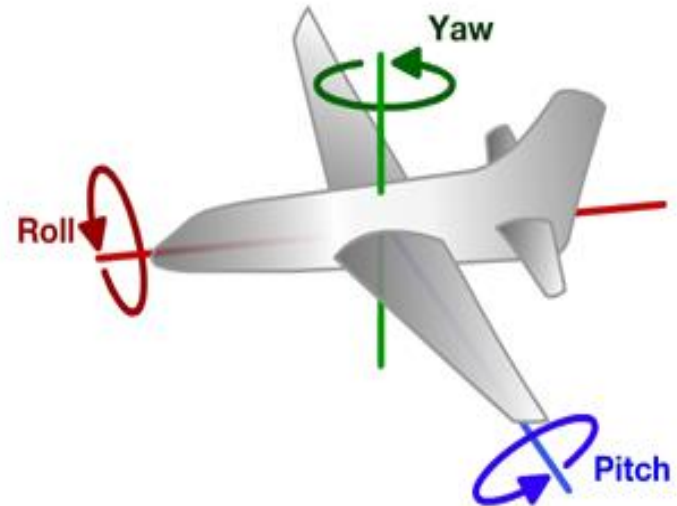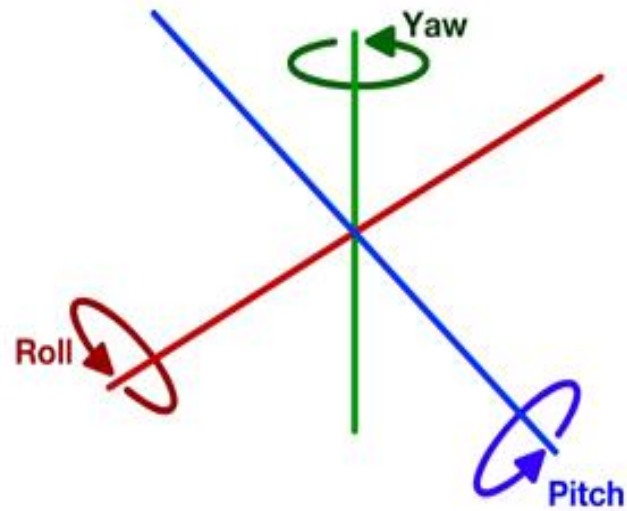
Moving Foreground

KLT Feature Tracker

- SURF Points extracted from the initial frame
  - `detectSURFFeatures`
  - `extractFeatures`

- Track features between frame
  - Create object `vision.PointTracker`
  - Initialize with SURF points
  - Track across adjacent frames
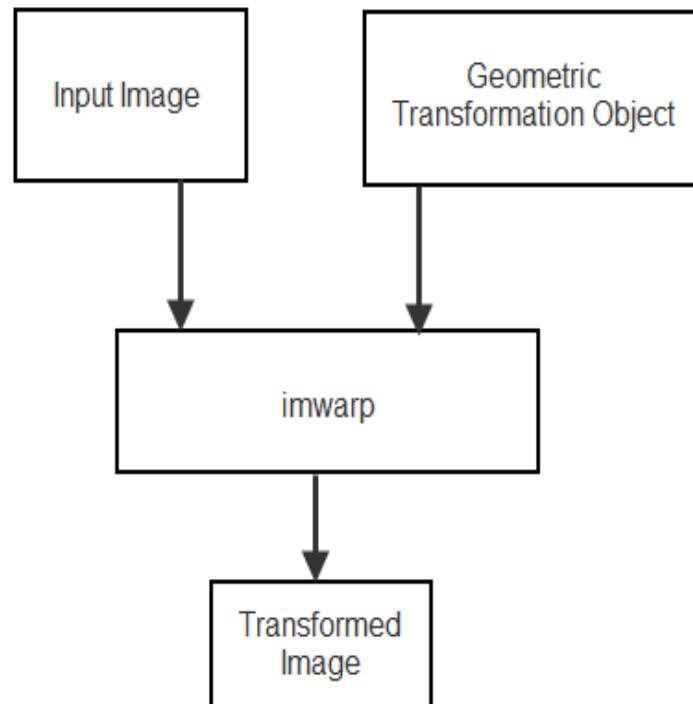
Roll Pitch and yaw

ESTIMATE GEOMETRIC TRANSFORMATION

- Fit geometric transformation to control point pairs between the Fixed and Moving Frame
  - Estimate 'Projective' Geometric transformation - `fitgeotrans`
  - Apply the transformation to Moving frame - `imwarp`
  - Adjust the X and Y bounds of the Fixed and Moving Frames

GEOMETRIC TRANSFORMATION

FRAME DIFFERENCING

Image normalization

Morphological operations and Connected Component Analysis

- Erosion and dilation - `imdilate imerode imclose`

- Fill holes in binary image - `imfill`

- Remove all connected components that have fewer than p no. of pixels to remove noise - `bwareaopen`

- Find Connected Components - `bwconncomp`

- Measurements - `regionprops`

Results video

Questions?

Thank You!