Center for Embedded Systems
An NSF Industry/University Cooperative Research Center

Registration and Fusion of EVS and SVS Runway Images for Embedded Systems

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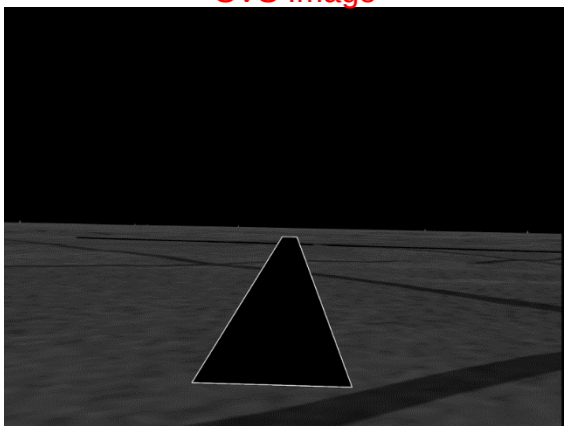
Project Overview and Description

Project Description

- The precise detection of runways is crucial for safely landing aircrafts because more than half of the accidents occur during the final approach and landing.
- The runway detection methodology being developed exploits information from enhanced vision system (EVS) and synthetic vision system (SVS) image frames of the runways.
- The goal is to generate image frames that contain enhanced runway and surrounding information by fusing the EVS and SVS frames.
- The resulting image frames can be incorporated into head-up displays (HUDs) to assist the pilot in landing the aircraft safely.

EVS Image

SVS Image



Approach

Novelty

1. Fusion of EVS and SVS images
2. Novel algorithms to:
   (a) Extract features from EVS and SVS images
   (b) Register EVS and SVS runway images
   (c) Fuse the registered images so that the information from both images can be displayed optimally
   (d) Simulate adverse weather condition images to objectively evaluate performance
3. Embed algorithms into multi-core processing environments for real-time applications

Benefits to member companies

1. Lead to the development of novel landing heads-up display systems
2. Will also be applicable to a vast range of other problems at Rockwell Collins involving image registration and image fusion.

Project Status

- **Progress to date**
  - **Developed a novel approach to use the weather-invariant SVS image information to accurately detect the runway in the EVS image**
  - **Developed fusion methods to generate an EVS-SVS composite image which contains information from both images**
  - **Tested the methods developed using real EVS and SVS landing images provided by Rockwell-Collins**
  - **Developed a model to simulate varying degrees of atmospheric turbulence in EVS images to conduct objective performance evaluations**

Project Tasks/ Deliverables

	Description	Date	Status
1	Preliminary EVS images processing and runway feature detection	Year 1	Completed
2	Preliminary SVS images processing and runway feature detection	Year 1	Completed
3	Preliminary EVS and SVS registration	Year 1	Completed
4	Preliminary EVS and SVS fusion	Year 1	Completed
5	Final EVS and SVS registration and fusion	Year 2	ongoing
6	Embed strategy into multi-core processing environments for real-time applications	Year 3	

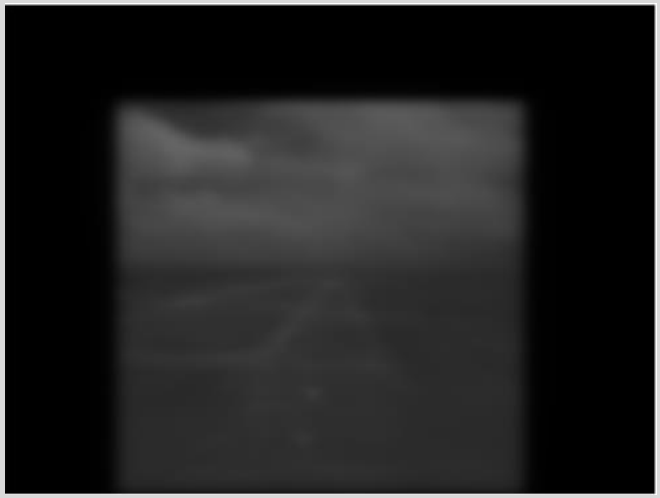
Deliverables

- **Technical background into image fusion and registration**
- **Algorithms to register and fuse EVS and SVS images**

Executive Summary

- **EVS and SVS Registration**
  - Line detection
  - Hough transform
  - Runway detection
  - Horizon detection
- **EVS and SVS Fusion**
  - DWT based fusion rules
- **Performance Evaluations**
  - Objective evaluations
  - Subjective evaluations

Original EVS



Registration & Fusion