BATTLEFIELD MODEL DESIGN

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Spectral Energies

WRIGHT STATE UNIVERSITY

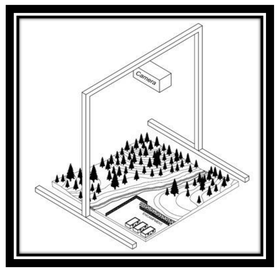
PROJECT DESCRIPTION:

The Artificial Intelligence Enhanced Imaging System (AIEIS) processes visual data by combining optical flow methods with artificial intelligence shape recognition. These systems are designed to identify targets of interest (i.e., weapons, vehicles, and soldiers) and provide motion and tracking data to the user. The project's goal is to provide proof of concept data that optical flow methods can be used to detect movement in a battlefield environment using a scale model.

DESIGN:

Determining Model Scale:

- A scale of 1:140 is selected for the design
- This balances commercial drone flying altitudes, camera specifications, and manufacturability



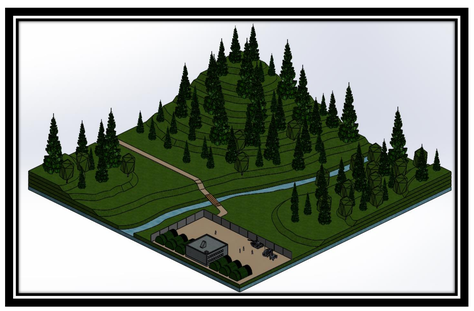
Camera Rail System

Camera Rail System Components:

- Gantry frame structure
- Motorized camera rail
- Aluminum extrusions
- Camera: PCO 1600

Designing The 3D Model:

- 2D layout is created from design sketches
- 3D model terrain is created in Blender®
- SOLIDWORKS® model is created for finalized design

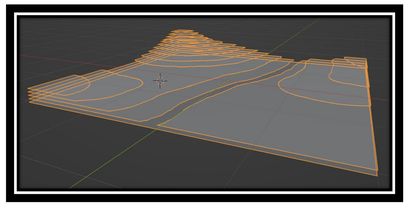


Final Model Design

CONSTRUCTION:

Terrain Construction:

- Terrain modeling is completed in Blender®
- Two-dimensional templates are acquired from the model
- Templates are used to guide the process of cutting foam
- Foam is layered, fastened, and coated with plaster



Model Slicing

Foam Layering

Plaster & Paint:

- Application of plaster smooths layers of the terrain and gives it a realistic surface texture
- Brown and green paint are applied afterwards
- Plaster assists in preventing the universal solvents in the paint from dissolving the foam

Terrain Base Coating

Model Components:

- River: two-part silicone mixture
- Road/Military Base: covered with sand to resemble packed dirt and gravel
- Fencing: made from wire mesh, rivets, and springs
- Trees: hand-crafted
- Vehicles & Soldiers: printed via SLA
- Buildings: carved from wood
- Boulders/Rocks: scattered across model

Final Model

TESTING & RESULTS:

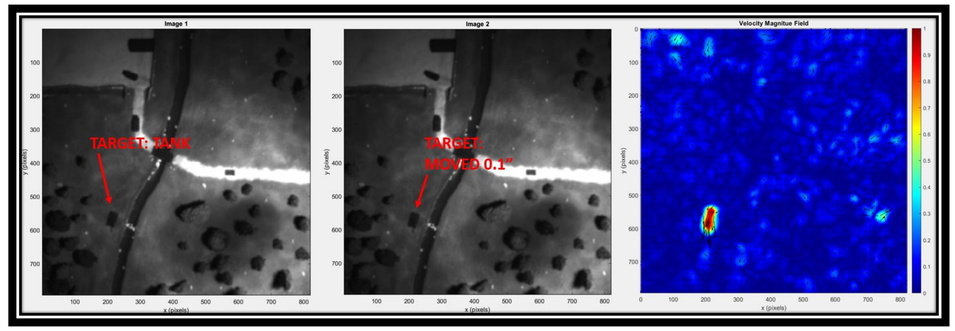
Testing:

- Testing Apparatus: shown to the right
- 32 tests were completed to validate hybrid optical flow detection methods

Optical Flow Plots:

- Hybrid Optical Flow method is utilized to evaluate our tests by comparing two images within the MATLAB program
- The images below show the velocity magnitude field output from two image inputs
- The tank is highlighted in red visualizing that a displacement has occurred
- The table lists testing results

Experimental Apparatus



Test Images & Velocity Plot

Target Shape	Target Size [pixels]	Target Disp. [pixels]	Target Disp. [inches]	Result [Pass/Fail]	Disp. Agree ±3/32"?	Size/ Disp.
Humvee	18.5	10	0.75	Fail	No	1.85
Humvee	18.5	5	0.375	Fail	No	3.7
soldier_prone	10	10	0.75	Fail	No	1
soldier_prone	30	30	0.75	Fail	No	1
soldier_prone	30	20	0.5	Fail	No	1.5
soldier_prone	30	10	0.25	Fail	No	3
soldier_prone	10	2	0.125	Fail	No	5
Tank	42.5	60	3	Fail	No	0.71
Humvee	27.5	5	0.25	Pass	Yes	5.5
Humvee	55	5	0.125	Pass	Yes	11
Humvee	27.5	2	0.1	Pass	Yes	13.75
soldier_prone	30	5	0.125	Pass	Yes	6
soldier_prone	15	2	0.1	Pass	Yes	7.5
soldier_prone	30	2	0.05	Pass	Yes	15
Tank	42.5	5	0.25	Pass	Yes	8.5
Tank	85	5	0.125	Pass	Yes	17
Tank	42.5	2	0.1	Pass	Yes	21.25

Results