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Vision Based Navigation

S&T Campaign: Sciences for Lethality & Protection
Low Cost Hyper Accurate Weapons

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Research Objective

The purpose of this research is to pursue autonomous navigation through visual cues. Image based measurements to estimate the vehicles attitude and geolocation would aid autonomous systems through GPS denied environments.

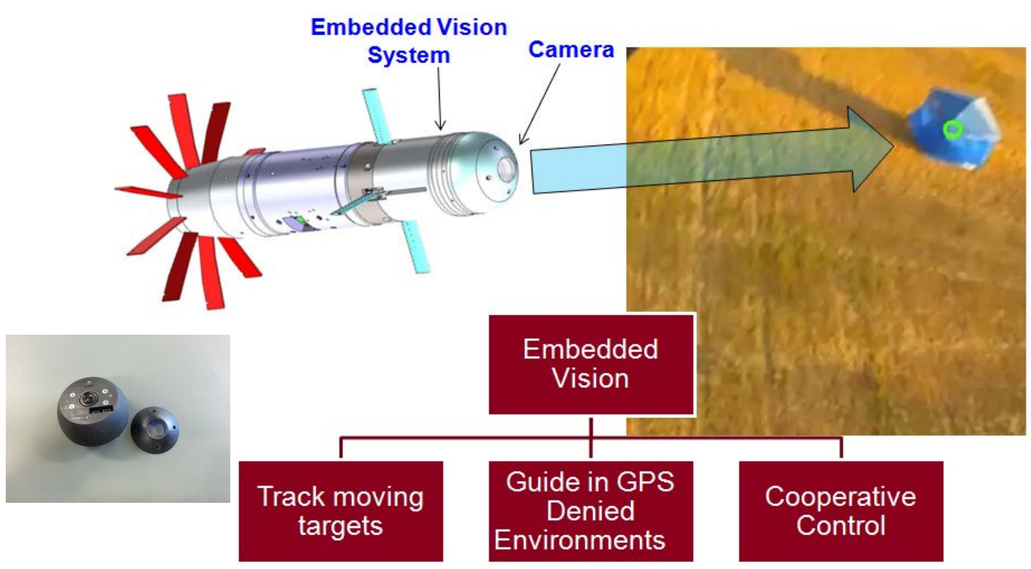

Fig 1. Vision system for smart projectile

Challenges

- **Inherent computational burden of computer vision algorithms.**
- **First frame target detection for smart projectiles is difficult with a dynamic scene.**
- **Camera challenges include low frame rates, blur, latency, etc.**

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- **Expertise sought in surveillance, fast computer vision methods and implementation, IR cameras.**
- **Innovative new research approaches to address this research objective include biologically inspired methods, compressive sensing, network control, etc.**

The purpose of this research is develop a robust vision-based navigation strategy for all conditions.

ARL Facilities and Capabilities Available to Support Collaborative Research

- **ARL technical expertise in gun launched embedded processing**
- **Integrated software / facilities for scene and camera modeling.**
- **Inertial Measurement Unit (IMU) Calibration and Modeling facilities**
- **Transonic and Air gun facility for small scale data collection and proof of concept demonstrations**
- **Unmanned Aircraft for data gathering and algorithm V&V**
- **Real-time hardware in the loop facilities including GNSS simulator.**

Photo credit, James Maley

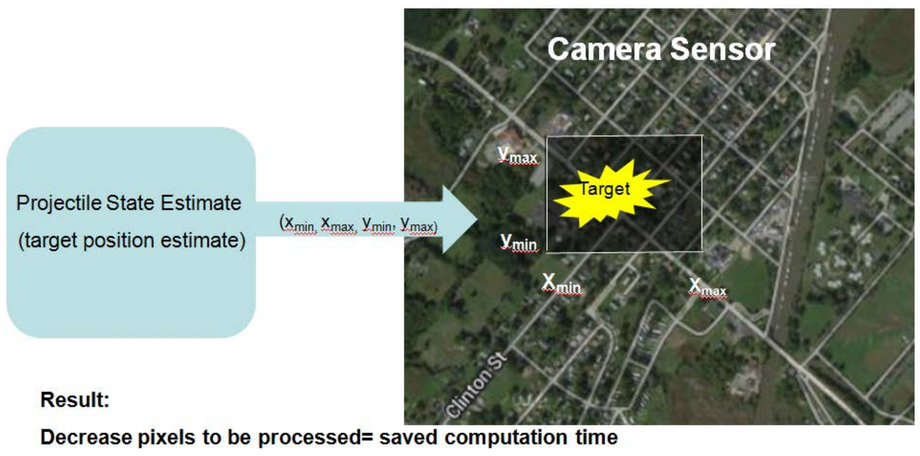

Fig 2. Using the Kalman filter to predict a window in the frame where the target is most likely to be, searching within this window significantly reduces computation

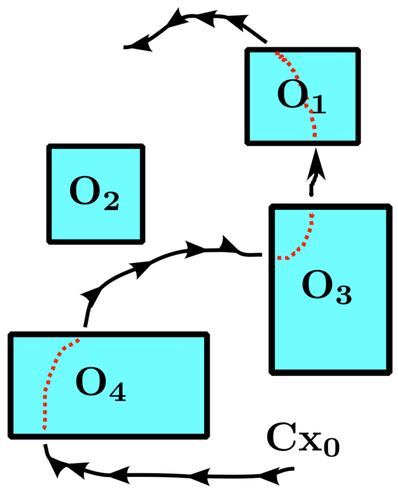

Photo credit, Cory Miller

Fig 3. ARL has expertise in developing algorithms for tracking through occlusion, and tracking multiple, similar looking targets.

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