# Display Computing - A new Paradigm, applied to the design of an AutoPilot system for single-camera drones and robots.

Author: Dr. Bheemaiah, Anil Kumar, Synergy Robotics, A.B

anilkumarbheemaiah@gmail.com,
8/21/2018 11.53 AM

Fig 1: PixHawk, a monocular autopilot for drones.

*Abstract*

*Display Computing is a new paradigm of GPU computing, where each image is computed from the previous images using generalized transformation theory. This is applied to monocular video for procedural and emergent A.I to create an autopilot for drones and robots. A microphone with the same A.I applied to audio infrasonic streams can supplement the autopilot system. This paper describes the mathematical models and algorithms.*

*Keywords: Transformational A.I, Emergent AI, SLAM, Display Computing, Auto Navigation, Drones.*

**Introduction.**

Monocular Camera, as a single sensor for the creation of auto navigation systems, is a mature and well-developed technology. There are many monocular systems for Drones and robots developed over the past two decades.

**LSD-SLAM** is a novel, direct monocular SLAM technique: Instead of using keypoints, it directly operates on image intensities both for tracking and mapping. (“Website” n.d.)

The camera is tracked using direct image alignment, while geometry is estimated in the form of semi-dense depth maps, obtained by filtering over many pixel-wise stereo comparisons. (Caruso, Engel, and Cremers 2015; Engel, Stuckler, and Cremers 2015)

## Display Computing.

Display Computing is a paradigm of transformational A.I , invented by the author for sensor stream-based transformation and M.L based on transformational A.I by transformation to a counting space. Based on the theory of generalized transformations, of which Fourier, Laplace, and greens functions are special cases, there are two separate disparate realms of computing, that of the countable C, and that of the beyond counting BC.
There always exists a transformational space or a set of spaces in which we can define a transformation from the sensor event and computational space, E to the space of counting C or set of counting spaces, $\Sigma C$ , and a metric called meta-frequency or belonging to another field, F similar to reals, complex, tensors or any other field structure or algebraic field.
Transformational A.I is thus defined as the computability in this field or an algebraic field.

A.I algorithms in other forms of computation can be mapped to transformational A.I by defining a sequence of transformations between the quantized sensor stream data and the output, by supervised or unsupervised learning, in a state or stateless model. A pure stateless transformational A.I exists for example in the case of displays, by the computation of the next display from the previous display or set of displays if stateful, with nay other models or input modalities. This is the foundation of distributed, processor less display computing. Display computing can thus be display centric with distributed sensors like pixel sensors for camera substitution and audio pixels as sensors for sound. WIth Thansformational A.I, LSD SLAM, VSLAM with a point cloud formulation and obstacle avoidance with deep cloud integration with cloud functions can be achieved similar to Nvidia RedTail and ArduPilot.

Monocular camera auto navigation.
Architecture and algorithms.
1. App developed, with an interface for skills.
2. Computation for segmentation and identification using DNNs on AWS(“Website” n.d.)or Google Cloud using Firebase ML Kit.

3. Emergent algorithms for track stability, cruise, automatic braking, obstacle avoidance.
4. Primary motion using the cockroach algorithm.
5. Integration with Google Maps and Google Earth, for computation of use of maps for trajectory computation and traffic avoidance.

**Definitions**

A track is defined as a trajectory, at the edge of an imagined trail from a starting point to a destination. It is assumed that a map of the place exists in google earth, either in the local cache or global one, if not the algorithm creates it.
There always exists a trail T from a start point to a destination, failing which
a. There are an obstruction and the algorithm halts in exception.
b. The trail is shifted to the left trail or right trail to avoid the obstruction using image transformation theory.
The stability theorem for the left and right trail is similarity defined.

**The cockroach algorithm.**

The leftmost trail is the stable trail and is followed, with left and right turns. In case of a left turn, the left-most trail is followed, in case of a right turn, the algorithm halts and calls the trail segmentation and crossing algorithms.

**Crossing algorithm.**

A 180 sweep motion for 30 frames, in display computing for moving objects and stationary objects, followed by a crossing.

Trail segmentation

We use a DNN for trail mapping from Google Earth images which is a solved problem(“Website” n.d.)(Ran et al. 2017)(Ran et al. 2017; “Website” n.d.)

References


Caruso, David, Jakob Engel, and Daniel Cremers. 2015. “Large-Scale Direct SLAM for Omnidirectional Cameras.” *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. https://doi.org/10.1109/iros.2015.7353366.

Engel, Jakob, Jorg Stuckler, and Daniel Cremers. 2015. “Large-Scale Direct SLAM with Stereo Cameras.” *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. https://doi.org/10.1109/iros.2015.7353631.

Ran, Lingyan, Yanning Zhang, Qilin Zhang, and Tao Yang. 2017. “Convolutional Neural Network-Based Robot Navigation Using Uncalibrated Spherical Images.” *Sensors* 17 (6). https://doi.org/10.3390/s17061341.

“Website.” n.d. Accessed July 30, 2019a. LSD-SLAM https://vision.in.tum.de/research/vslam/l

sdslam.
———. n.d. Accessed July 30, 2019b. Amazon AWS Deep Learning AMI. https://aws.amazon.com/blogs/machine-learning/get-started-with-deep-learning-using-the-aws-deep-learning-ami/.
———. n.d. Accessed July 30, 2019c. Monocular Urban Localization using Street View, https://arxiv.org/pdf/1605.05157.pdf.
———. n.d. Accessed July 30, 2019d.