



Undergraduate Research by Rob Streeter
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***MUSCA DOMESTICA* BASED
MACHINE VISION SENSOR;
SENSOR CHARACTERIZATION**

Outline

- ① Background
- ② Research objectives
- ③ Methods
- ④ Results
- ⑤ Applications
- ⑥ Conclusions
- ⑦ Acknowledgements

Background

- ⦿ Ongoing project
 - Undergraduate
 - Graduate
 - Doctorate
 - Post-doctorate
- ⦿ Fly-based Testing
- ⦿ Model Development
- ⦿ Prototype Design, Testing, and Characterization

Fly-based Tests and Model Development

- ① *Musca domestica* eye tests (“fly-eye”)
- ① Fundamental mathematical analysis
 - Development of mathematical modeling
 - Basis for prototype development

Prototype Design

- ⦿ Initial prototypes
 - Difficult to build
 - Limited capabilities

- ⦿ Current prototype
 - Light-adapted
 - Filtered
 - “Easy” to build

$$D1_{\text{adapted}} = D1 - (1/7) * \sum D_i$$

(distance from mean)

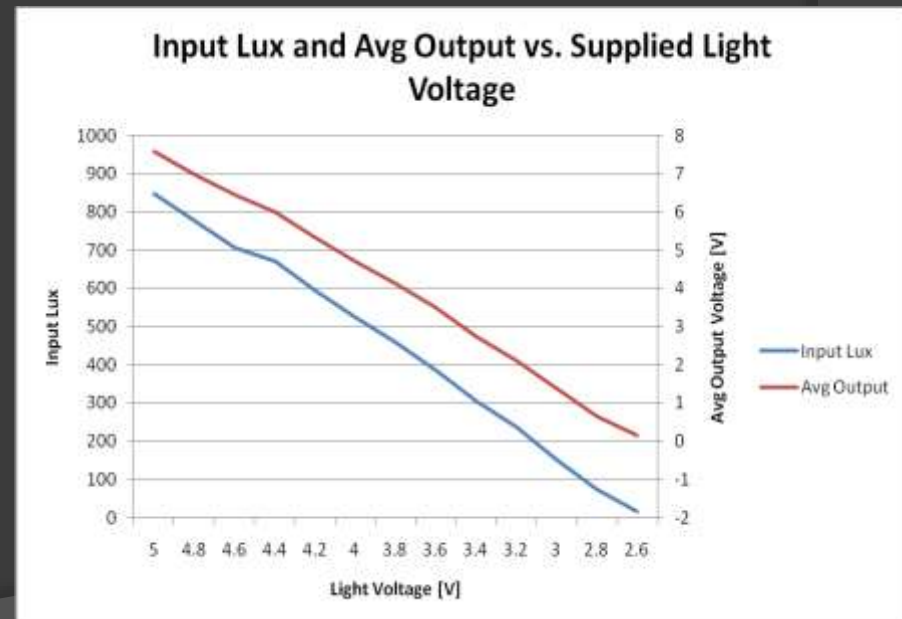


Research Objectives

- ⦿ Layout and build sensor
- ⦿ Conduct characterization tests
 - Ambient light reaction
 - Maximum / minimum range
 - Minimum contrast
 - Horizontal motion test
- ⦿ Compile results into a report
 - Compilation led to discovery of artifacts

Ambient Light Reaction

- ⦿ Light-box environment
- ⦿ Linear relationship between average output and input lux
- ⦿ Minimal distortion on individual channels

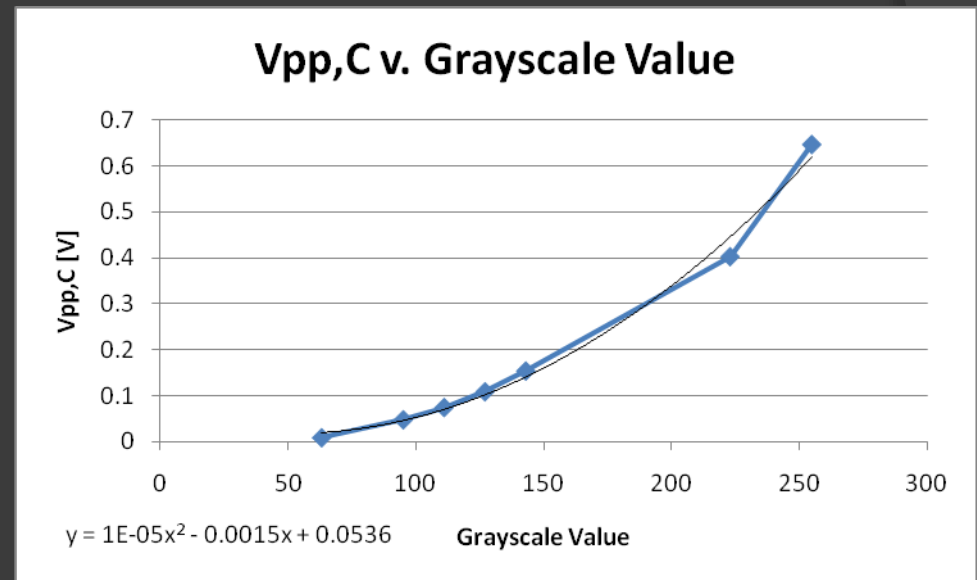


Maximum / Minimum Range

- ⦿ No definite “max,” however the signal strength was reduced 77% at 45°
- ⦿ Maximum angular displacement changed from 33.4° to 11.4°
- ⦿ Similar set up described later in Horizontal 1-D Motion

Minimum Contrast

- Exponential increase in output voltage as contrast increases



- Interesting discovery: if 000 is “pure black,” our “black” dowel is close to a 063

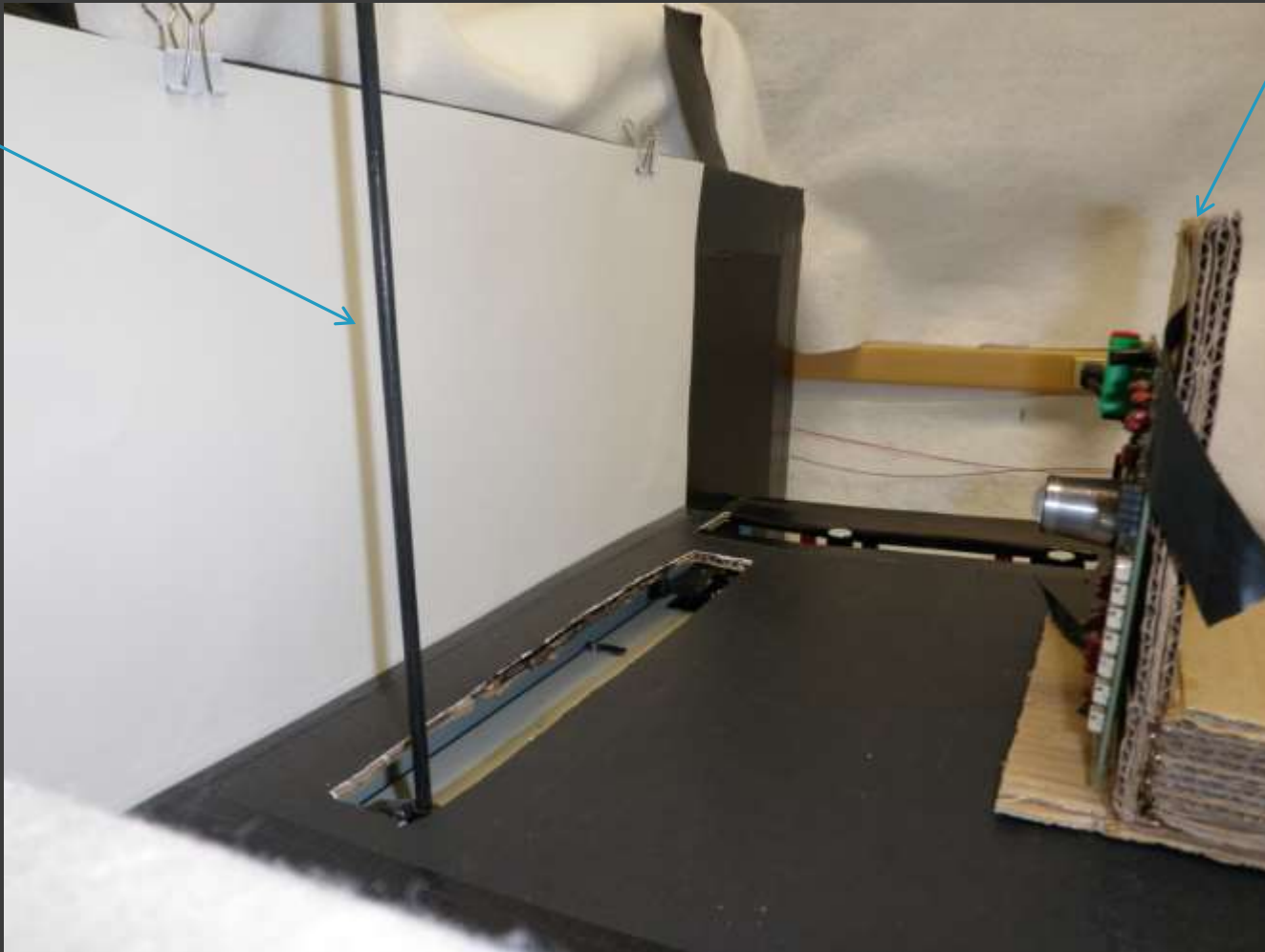
Horizontal, 1-D Motion

⦿ Horizontal Motion Test

- Uses a dowel moving in one-dimension (left – right)
- Response of 3 photodiodes measured and plotted versus time

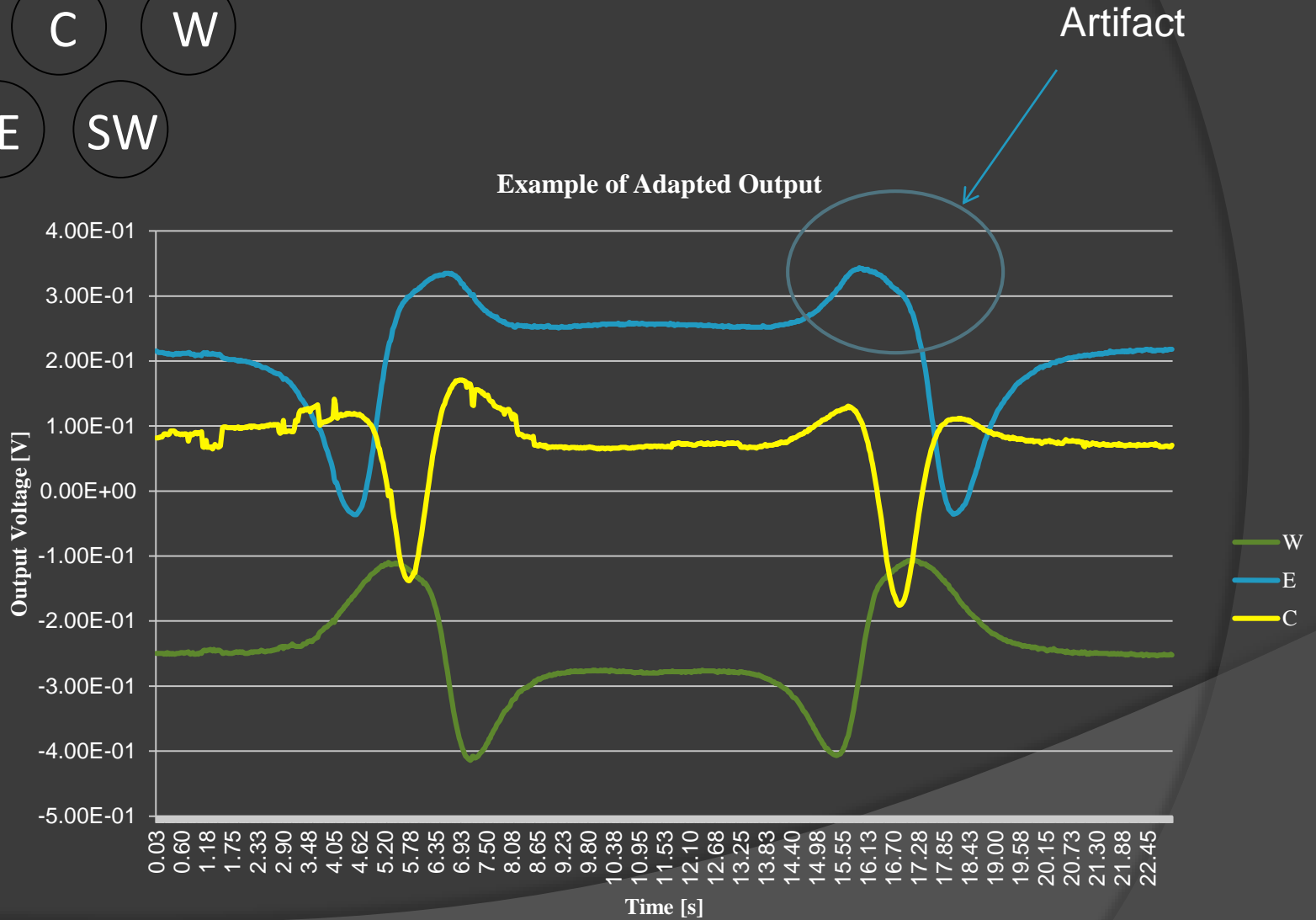
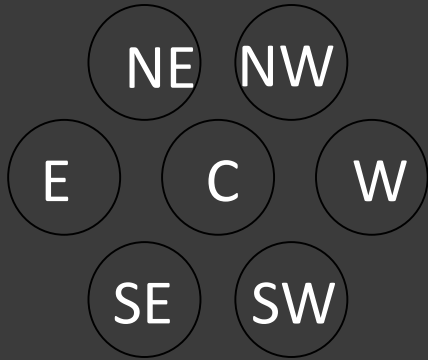
Methods

Moving
Dowel



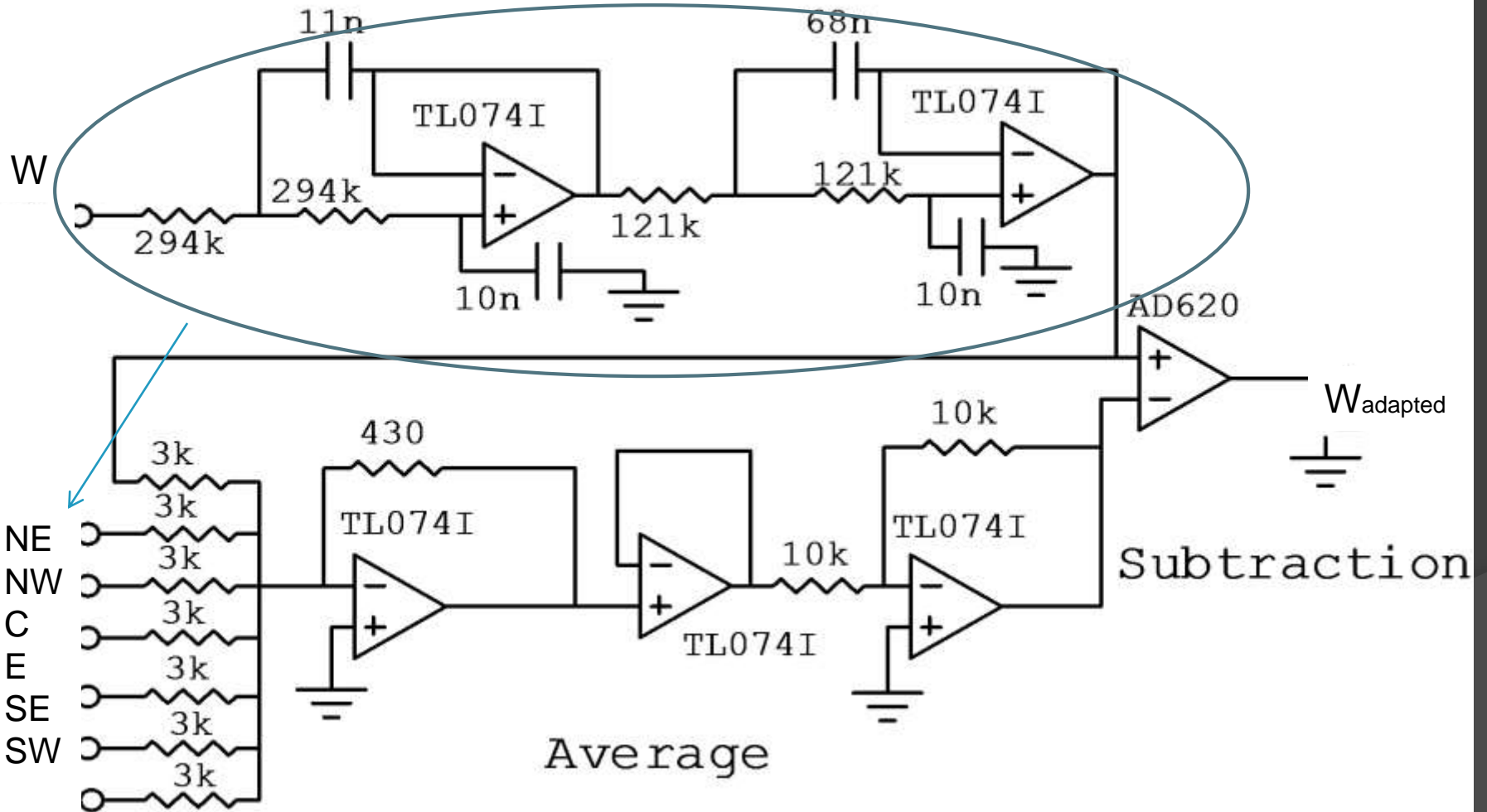
Sensor
Mount

Results



Circuit diagram

Filter



Applications

- ⦿ Edge-detection
- ⦿ Hyper sensitive to motion
- ⦿ Low contrast conditions
- ⦿ Civil and Military

Conclusions

- ◎ Light-adaptation:
 - Improves robustness
 - Provides for single-diode horizontal motion direction through artifacts
 - Minimizes hardware requirements
 - Improves speed and efficiency

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