These properties allow us to closely monitor the effects of treatments before, during, and after organ development within the first five days after fertilization. In addition, zebrafish share a remarkable degree of genetic similarity to humans, having similar genes to at least 70 percent of all human protein-coding genes. Thus, the data generated from this study is likely predictive of potential adverse effects in humans.

We screened nine BAH analogs (2-ABAH, 4-ABAH, 3-DMABAH, NaN3, 4-FBAH, BAH, 4-NBAH, 4-TFMBAH, and isoniazid) for effects detrimental to proper organ development. Initially, 6 concentrations of each analog were added to groups of 40 embryos six hours post-fertilization, at which time gastrulation had just begun. In a second assay, we measured toxic effects on cardiac function by adding the compounds to embryos at 2 days post-fertilization, after the heart was developed. In both techniques wild-type (AB) and pigmentation mutant (Casper) embryos were observed for 5 days and grown under normal conditions, except that 0.4% DMSO was added to aid in chemical absorption.

If any, the primary defects observed after treatment during early development were pericardial edema and pooling of blood cells in the tail region, hereafter referred to as circulatory abnormalities (see Figure). Our studies found treatment with 300μM of NaN3, 4-NBAH, and 4-TFMBAH caused circulatory abnormalities in all embryos, with these defects appearing less frequently as dosage was lowered. Both NaN3 and 4-NBAH have an estimated EC50 of 150-300μM, while the estimated EC50 of 4-TFMBAH is 120-150μM. For all other chemicals, fewer than 25% were affected with doses up to 300μM. In our assay for effects on cardiac function, we found circulatory abnormalities only with NaN3 and 4-TFMBAH treatments at doses of 80-300μM (not shown).

Our results suggest that 2-ABAH, 4-ABAH, 3-DMABAH, 4-FBAH, BAH, and isoniazid cause little to no developmental or organ toxicity when administered at dosages of 300μM and below, thus making them ideal candidates for further in vivo testing of MPO-inhibitory function.

Our immediate future plans include LC50 determination for the above drugs and screening a new panel of 60 small molecule MPO inhibitors. Additionally, we will use transgenic zebrafish lines with either fluorescent neutrophils or blood vessels to study the impact of MPO inhibition on normal inflammation and circulation, respectively.

**Statement of Research Advisor:**

Andrew’s toxicity analysis of these compounds is part of a drug discovery process that allows us to reduce the number of potential drugs prior to further animal testing, thus lessening the number of mice or other species required. Discovery of new therapeutics for detrimental effects of the inflammatory process may prove useful in treatment of patients with rheumatoid arthritis, cancer, and cardiovascular disease.

- Jennifer Panizzi, Anatomy, Physiology, and Pharmacology

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**Depth Estimation with a Plenoptic Camera**

*William Roberts*

The Advanced Flow Diagnostics Laboratory (AFDL) at Auburn University has recently built a novel device called a plenoptic camera. This device is constructed like a conventional DSLR camera with an array of microlenses mounted in front of the sensor chip. Light passes through the microlenses in a way that allows the camera to capture both the location and angle at which light rays impact the image sensor. Because of this, the photographer captures the complete four-dimensional light field with a single exposure and can change the viewing perspective using image processing after the image has been taken. It is then possible to
estimate the distance of an object from the camera. The human brain perceives depth in exactly this way – interpreting depth by comparing the perspective of each eye. Traditionally, optical depth estimation is performed in stereo, using two cameras, but this requires extensive calibration and high financial cost. Instead of only two lines of sight, the plenoptic camera inherently records many (over 100) with a single snapshot – providing far more perspectives for comparison. This could significantly reduce the complexity, size, and expense of current systems used for range-finding applications. Furthermore, the plenoptic camera is a passive sensor, unlike LIDAR and structured light sensors which must emit a signal to calculate depth. This makes the plenoptic camera less prone to detection in military applications.

This research focused on the development of an image processing algorithm that uniquely exploits plenoptic image data to compute a depth-map of the scene. In the finished algorithm, features in a perspective image are compared to a template image and the apparent motion, or “disparity”, of that feature is estimated. A number called a “confidence coefficient” is assigned to that feature to indicate the probability that the disparity calculation is correct. The algorithm proceeds in this way through every possible perspective of the scene until a great many perspective images have been processed. When disparity estimates have been calculated on every image, they are averaged together. Disparity estimates with high confidence are given more weight than estimates with low confidence during the averaging process. Using the principles of geometric optics, the disparity estimates can be converted into a depth map, as in the example image shown in the figure. The image on the left is a sample perspective image generated by the camera. On the right is a depth map showing near and far objects after processing.

The algorithm was tested with the plenoptic camera on a small static image target placed at several distances in front of a featureless background. Depth was recovered to within five percent error, validating the algorithm. Future work will focus on computational efficiency so that plenoptic cameras can be used for range-finding applications such as UAV navigation and obstacle avoidance.

**Statement of Research Advisor:**

Due to the fundamental way that they record 3D information about a scene, plenoptic cameras have the potential to supplant traditional cameras in a large number of applications and settings. William’s work exploits the unique nature of these cameras to produce 3D images and is critical in advancing the capabilities of these cameras.

- Brian Thurow, Aerospace Engineering

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**Figure, Roberts.** Sample plenoptic image with depth map, illustrating near (red) and far (blue). Note issues with accurately interpreting reflections and the edges of objects.