Developing a Motorized UV Illuminator Device for Photochemical Ligand-Binding

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Observing the location and role of proteins in physiological processes is a major challenge in the field of life sciences, as most clinical drugs exert their effects through protein modulation. To better understand protein function and develop improved medications, protein imaging techniques are necessary. Immunohistochemistry is a common method for fluorescent imaging, but it has limitations, such as the lack of specific antibodies for certain proteins. Ligand-based labeling offers several advantages over immunohistochemistry, but it presents its own challenges. Radioligand labeling has low spatial resolution and can be problematic due to the use of radioactive isotopes. Fluorescent ligands, however, offer a much higher spatial resolution, with diffraction-limited microscopy achieving a resolution of around 200nm and super resolution fluorescence methods achieving a resolution of approximately 20nm. One major issue with ligand-based labeling is that small molecules tend to dissociate rapidly from their target proteins, causing the labeling to fade quickly and potentially rendering the technique inefficient. To address this issue, photoaffinity ligands can be applied, which stabilize the ligand-protein complex by covalently attaching to the target upon UV irradiation. The chemical basis of photoaffinity labeling is well-established, but protein staining with fluorescent photoaffinity ligands is not commonly used due to the lack of appropriate equipment for UV illumination of biological samples. To overcome this limitation, my goal is to build suitable equipment for the UV illumination of biological samples, which will enable the routine use of protein staining with fluorescent photoaffinity ligands for microscopic purposes.

Awards Won:
International Council on Systems Engineering - INCOSE: Certificate of Honorable Mention, a 1-year free student membership to the INCOSE, and free virtual admission to the 2022 International Symposium of the INCOSE