Making the Invisible Visible: Kinetic Bioluminescence Image Analysis with Unsupervised Machine Learning

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Preclinical optical imaging is a crucial tool for biomedical research. Researchers use imaging techniques to observe and quantify biological processes in living laboratory animals, which can aid in the development of novel therapies and treatment options. The scientific community agrees on the importance of reducing animal experiments and the attendant distress they cause to subjects. To this end, the introduction of intelligent systems into image processing could improve the efficacy and humanity of preclinical experiments. Similarly, machine learning algorithms require large datasets for training purposes, which are often challenging to generate using real-world data.

Herein, we propose a flexible system to generate synthetic preclinical images using Blender freeware with a Python module capable of producing various noise models mimicking image sensor behavior at various lighting conditions. The proposed system can also be used for dataset generation and is a practical and computationally inexpensive solution to train various machine learning models.

In order to test our system, we have developed a Flask application with several embedded machine learning techniques. We have successfully tested the performance of our system using a variety of kinetic imaging scenarios and mimicking low light level conditions with significant noise contamination.