

A novel solution to single particle tracking using deep recurrent neural networks

(Literature Review)

The ability of tracking particles based on microscopic video frames is a problem which has been investigated for decades. Improving the accuracy of this operation can lead to ground-breaking new discoveries in the area of biology like understanding and curing certain diseases. As stated in the *Single-particle tracking* (SPT) Wikipedia page [1], SPT is the observation of motion of individual particles within a medium. With analyzing the path (trajectory) of individual particles, information about the dynamics of the specific particle can be extracted. These dynamics let us observe interactions with other particles and how this can affect the overall system.

Our area of focus is analyzing the motion of G protein-coupled receptors (GPCRs) which, according to the paper *Single Molecule Imaging of GPCR Interactions* [2], mediate the effects of large number of hormones and neurotransmitters, are implicated in several human diseases and represent major pharmacological targets. Because of their fundamental role, heavy research in this area has been done in the past years. Recent improvements in the single-molecule microscopic methods have revealed that these particles constantly interact with each other in an unstructured way. This leads to developing ways of efficiently tracking these movements and analyze their results. One of the first investigations of that kind was performed in Akihiro Kusumi's laboratory and later Kasai et al. published another study.

Developing an efficient way of analyzing GPCRs first starts with understanding the existing applications and their performance. As stated in the paper *A review of progress in single particle tracking*, one highly effective way used by many biologist is FRAP. It can be applied to study protein dynamics within a cell, which is exactly what the focus on this project is. Another powerful method mentioned in this paper is FCS. Unfortunately, those methods struggle with analyzing the dynamics between sort-lived molecular interactions.

In progress...

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