

Time Delay Estimation in Gravitationally Lensed Photon Stream Pairs

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this is the abstract

1 Introduction

- explain the project in layman's terms

2 Background

- Ideas behind the project
- what it's useful for
- what gravitational lensing and time delay are

3 Photon Stream Simulation

In the early stages of the project, we developed a subsystem which could be used to generate simulated photon stream data to use for the development and testing of the rest of the project. The only property of the photons which we are interested in is their arrival time at our capture device, so the simulator should produce some vector $\Phi = [\phi_0, \dots, \phi_N]$, $\phi_n \in \mathbb{R}$, where ϕ_n is the arrival time of the n th photon. In order to generate arrival times, we represent the source as some random variable X , which defines the average number of photons per unit time that arrive at the capture device. The behaviour of X is modelled as a non-homogeneous Poisson process (NHPP) with continuous rate function $\lambda(t)$. The rate function can be specified either by providing an expression which is a function of t , or by sampling from a randomly generated function. Random functions are constructed by uniformly distributing M Gaussians across the interval $[t_0, T]$. Thus, the simulator creates a very simple model of a source object form which to generate photon arrival times.

The function $\lambda(t)$ is the characteristic function of the object from which the photon stream propagates, and defines the arrival rate of photons at some time t . Given that the

4 Function Estimation

- Basic explanation of the IWLS estimator
- slightly more in-depth stuff for the development of our estimators

5 Time Delay Estimation

5.1 PDF Method

5.2 Area Method

6 Experimental Results

- general explanation of the experiments performed
- how was model selection done
- what sort of data were experiments performed on

7 System

- very brief explanation of the system features

8 Conclusion

- some suggestions for extensions