Title: Imaging with The Event Horizon Telescope

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Recently, there has been an international effort to create an Event Horizon Telescope (EHT) capable of imaging a black hole's event horizon for the first time. Imaging distant celestial sources, such as the event horizon of a black hole, with high resolving power (i.e. small angular resolution) requires telescopes with prohibitively large diameters due to the inverse relationship between angular resolution and telescope diameter. Although a single telescope is unrealizable, by simultaneously collecting data from an array of telescopes located around the Earth, it is possible to emulate samples from a single telescope with a diameter equal to the maximum distance between telescopes in the array. Using multiple telescopes in this manner is referred to as very long baseline interferometry (VLBI).

The challenges in reconstructing images from high resolution VLBI data are immense. The data is extremely sparse and noisy, thus requiring statistical image models such as those designed in the computer vision community. Current methods used for VLBI image reconstruction either make use of simple priors unsuitable for a wide range of possible source emissions, or require significant parameter tuning that may be prohibitively difficult for a new user to master. We present a novel, robust Bayesian approach for VLBI image reconstruction that requires minimal parameter tuning. The success of our method is demonstrated on realistic synthetic experiments as well as publicly available real data. We also provide a dataset and website (vlbiimaging.csail.mit.edu) to allow for controlled comparisons across algorithms. This dataset will foster development of new, robust methods by making VLBI easily approachable to researchers.