Matrix Multiplication Implementation for Pre Conditioning Back Propagated Errors on a Multi-Conjugate Adaptive Optics System

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The UCSC Laboratory for Adaptive Optics (LAO) currently has an adaptive optics system that is capable of solving a system of equations representing the atmospheric phase delays as light rays passes through the atmosphere. A laser guide star is shot from earth into the sodium ions which reside just above the earth's highest layer. As these ions are charged they emit energy in the form of light and this light then travels back through the atmosphere. The atmosphere is essentially sections into three dimensional rectangles, called voxels, and each one of these atmospheric voxels contributes its own unique phase delay to light as it travels from space to the lens of an earth bound telescope.

The current project will attempt to solve these equations by utilizing an iterative approach. The implementation of a matrix multiplication process will dramatically reduce the convergence time of our multi-conjugate adaptive optics system. While this significantly increases the time to calculate new values in an iterative algorithm, the approach reduces the number of iterations needed to converge to a solution. Once the calculation of error from the multi-conjugate AO system has been calculated, a matrix multiplication will be performed on them. Each error value, corresponding to three dimensional voxels in the atmosphere, will be multiplied by a Guide Star x Guide Star size matrix; which will consist of values accounting for the configuration of guide stars. It is anticipated to reduce the number of iterations needed to converge by a factor of 50.