tances" greater than the tallest object under study.

The Monte Carlo simulation tool uses several random state machines to generate x–y origin of leaders and peak stroke currents. The structures under study are entered in text files whose names are used as descriptors for report purposes. So, "External_tank.txt" could be the text file that contains all the vertices of the external tank. The lines of the text files contain three points (x, y, and z) that define "points" of lines or "vertices" of polygons. A line composed of three zeros (0 0 0) is used to indicate the end of a line or polygon.

Imaginary spheres (whose diameters are the striking distances) are drawn as the leader descends vertically to ground, and the first object intersected is considered to be struck. Therefore, the last step of the leader can be in any direction. The leaders can move in the z direction only, or in a random xyz direction (software selectable). The leader steps can be either fixed or variable. The length of the study is also software selectable, so the user can perform a study of "n" number of years. A summary report generated by the software indicates the frequency at which objects under study will be struck by lightning.

Adaptive MGS Phase Retrieval

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Adaptive MGS Phase Retrieval software uses the Modified Gerchberg-Saxton (MGS) algorithm, an image-based sensing method that can turn any focal plane science instrument into a wavefront sensor, avoiding the need to use external metrology equipment. Knowledge of the wavefront enables intelligent control of active optical systems.

The software calculates the optical path difference (wavefront) errors in the exit pupil of an optical system using only intensity images of a point of light. The light input may be a star, laser, or any point source measured at symmetric positions about focus and at the pupil. As such, the software is a key enabling technology for space telescopes. With only a basic understanding of the optical system parameters (e.g. imaging wavelength, f/number, measurement positions, etc.), the software evolves an internal model of the optical system to best match the data ensemble. Once optimized, the software proceeds to accurately estimate the wavefront of light as it travels through the optical system.

The MGS software is highly adaptable to a large range of optical systems and includes many innovative features. This version does not require an extensive and complete understanding of the system under test. Instead, using Automatic Model Adaptation, only the most basic system characteristics must be known. The algorithm adapts these parameters to best fit the data ensemble. These steps are crucial in achieving extremely high accuracy in the wavefront solution at the system exit-pupil. In addition, a convergence-monitoring feature allows the algorithm to stop when the wavefront solution has been reached to within a specified error tolerance level.

The software also facilitates the application of prior system knowledge to better deal with high-dynamic range wavefront errors. This is especially important where the error magnitude is much greater than the imaging wavelength (a significant problem in wavefront sensing). The software can use wavefront models based on previous runs or optical measurements, or predictions from external models, to initiate a prior phase estimate, through its Prior Phase Builder Graphical User Interface. The prior phase is treated by the software as a Numerical Nulling Reference, which is evolved in an outer-outer loop during computation, until it contains the full solution. The innermost iteration then has the simpler job of estimating the low-dynamic range residual difference of the true wavefront error from the Nulling Reference model. This allows the inner loop to operate around null, where it is most accurate and robust.

In addition to the wavefront solution, the software can provide an improved set of system parameters. For example, the result can report the true position of best focus and true f/number in the optical system.

Simulating the Gradually Deteriorating Performance of an RTG

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Degra (now in version 3) is a computer program that simulates the performance of a radioisotope thermoelectric generator (RTG) over its lifetime. Degra is provided with a graphical user interface that is used to edit input parameters that describe the initial state of the RTG and the time-varying loads and environment to which it will be exposed. Performance is computed by modeling the flows of heat from the radioactive source and through the thermocouples, also allowing for losses, to determine the temperature drop across the thermocouples. This temperature drop is used to determine the open-circuit voltage, electrical resistance, and thermal conductance of the thermocouples. Output power can then be computed by relating the open-circuit voltage and the electrical resistance of the thermocouples to a specified time-varying load voltage.