Bias is caused mainly by stray light and nonuniform distribution of light in a background image.
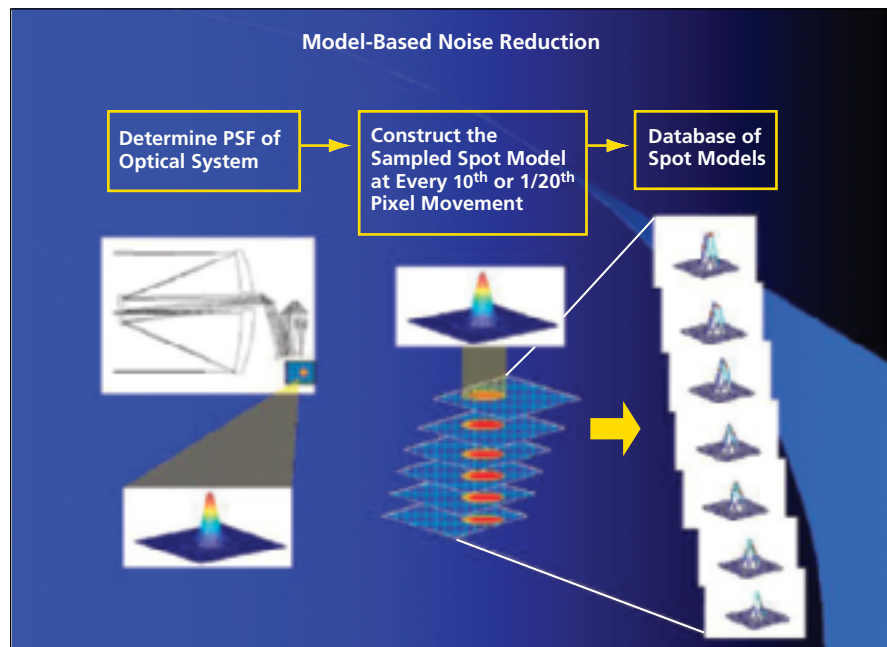
In the present method, prior to normal operations of the CCD, one measures the point-spread function (PSF) of the telescope or other optical system used to project images on the CCD. The PSF is used to construct a database of spot models representing the nominal CCD pixel outputs for a point light source projected onto the CCD at various positions incremented by small fractions of a pixel (see figure).

During normal operation of the CCD, the centroid of the image of a point source of light is initially computed from the digitized CCD pixel outputs in the conventional way. However, this initial computation of the centroid is used to retrieve the corresponding spot model that was constructed earlier. Then the boundary between noise and signal is determined by comparing the spot model with the CCD pixel outputs. Pixel positions of same pixel value of the spot model and the image data in the background area are defined as the boundary. All pixels of the image data beyond this boundary are set to zero. This effectively removes the noise and bias in the subsequent centroid estimation from the corrected image data.

Model-Based Noise Reduction

Determine PSF of Optical System → Construct the Sampled Spot Model at Every 10th or 1/20th Pixel Movement → Database of Spot Models

Spot Models are constructed from the measured PSF. The spot models are thereafter used in processing digitized CCD outputs to correct for bias and noise to refine centroid estimates.

*This work was done by Shinhak Lee of Caltech for **NASA's Jet Propulsion Laboratory**. Further information is contained in a TSP (see page 1).*
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Adaptive Modeling Language and Its Derivatives

Modeling language enables automation of the entire product development cycle.

TechnoSoft, Inc., Cincinnati, Ohio

Adaptive Modeling Language (AML), developed by TechnoSoft, Inc., is the underlying language of an object-oriented, multidisciplinary, knowledge-based engineering framework. TechnoSoft is a leading provider of object-oriented modeling and simulation technology used for commercial and defense applications. AML offers an advanced modeling paradigm with an open architecture, enabling the automation of the entire product development cycle, integrating product configuration, design, analysis, visualization, production planning, inspection, and cost estimation.

The AML framework is truly adaptive. Its successful history includes a wide variety of defense and commercial applications including aerospace, automotive, and capital equipment.

TechnoSoft has worked with the Vehicle Analysis Branch (VAB) at NASA LaRC on the development of the Collaborative Hypersonic Airbreathing Vehicle Environment (CoHAVE) built using AML. The collaborative enterprise environment of CoHAVE and its criteria-management environment are applicable to the design of NASA, military, and private commercial vehicles.

CoHAVE is applicable to the Reusable Space Transportation System's product area for evaluating the architectures of the Space Transportation Architecture Studies and Second Generation RLV Studies. Elements of this architecture include enhanced Shuttle, Reusable Two Stage to Orbit, and Venture Star (an SSTO design). Complementary to these delivery vehicles are Orbital Transfer Vehicles, Crew Transfer and Crew-Cargo Transfer Vehicles, and the Reusable First Stage Booster for Space Shuttle Upgrades. CoHAVE is platform independent and enables multiple users to collaborate across geographically-distributed, heterogeneous workstations. CoHAVE provides a comprehensive environment that facilitates the performance of concurrent engineering of hypersonic airbreathing vehicles at a level not currently available.

Recently, CoHAVE has been extended to incorporate models for other applications such as re-entry vehicles. Since the environment now includes vehicles other than traditional hypersonic airbreathing vehicles, the name has morphed into the Advanced Vehicle Integration and Synthesis Environment (AdVISE).

*This work was done by Adel Chemaly of **TechnoSoft, Inc.** under a NASA Small Business Innovation Research (SBIR) contract monitored by **Langley Research Center**. For further information, contact:*
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