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Networks for Image Acquisition, Processing, and Display

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The human visual system comprises layers of networks which sample, process, and code images. Understanding these networks is a valuable means of understanding human vision and of designing autonomous vision systems based on network processing. Ames Research Center has an ongoing program to develop computational models of such networks.

The models predict human performance in detection of targets and in discrimination of displayed information. In addition, the models are artificial vision systems sharing properties with biological vision that has been tuned by evolution for high performance. Properties include variable density sampling, noise immunity, multi-resolution coding, and fault-tolerance. The research stresses analysis of noise in visual networks, including sampling, photon, and processing unit noises.

Specific accomplishments include:

- Models of sampling array growth with variable density and irregularity comparable to that of the retinal cone mosaic
- Noise models of networks with signal-dependent and independent noise
- Models of network connection development for preserving spatial registration and interpolation
- Multi-resolution encoding models based on hexagonal arrays (HOP transform)
- Mathematical procedures for simplifying analysis of large networks

This program has resulted in six papers published or in press during the last year. Portions of this work were done in collaboration with Stanford University.