Highly Pixelated Hypertemporal Sensors for Global Awareness

LDRD
LABORATORY DIRECTED RESEARCH & DEVELOPMENT

Sandia National Laboratories

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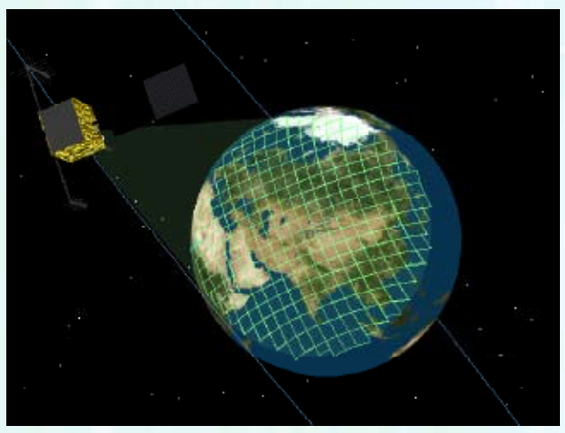
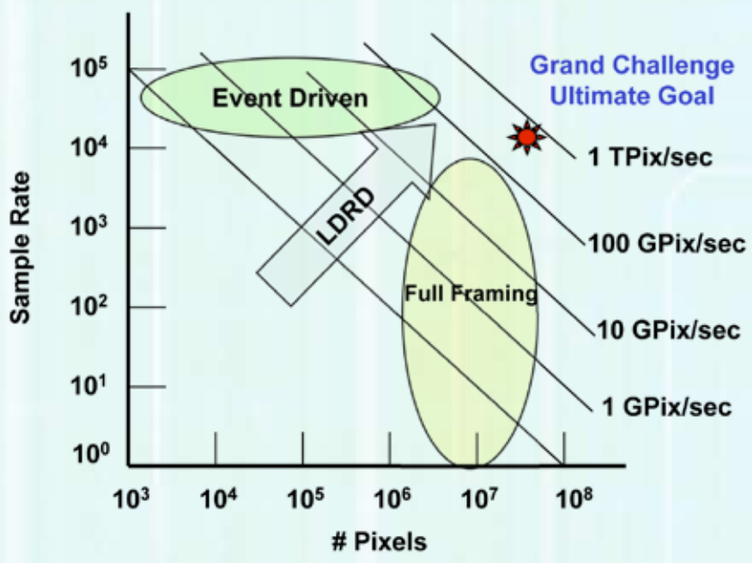
Sandia has a long history providing global coverage transient event monitoring
- – Wide field of view sensors
- – Multiple satellite platforms

A national need exists to extend this pervasive coverage:
- Greater sensitivity
- Finer spatial resolution
- High sample rates for characterizing transient signals



Re-engineer high speed, high density focal plane sensor architectures to enable global persistent awareness of transient optical or infrared events

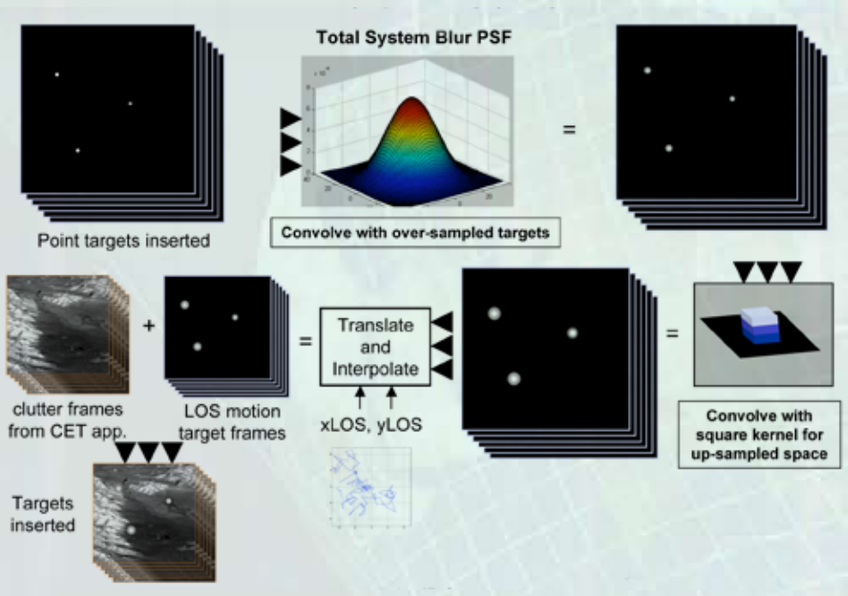
FPA TechnologyPixels x Sample Rate Space



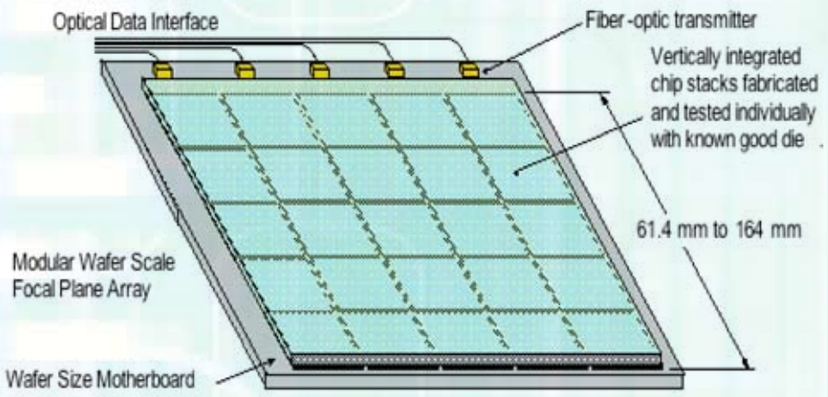
Approach: Multi-disciplinary Research

- **System and Modeling Team**
  - – Build an end-to-end model for candidate systems, including effects of satellite platforms
- **Silicon Circuits Team**
  - – Architect a realizable solution using state-of-the art integrated circuit technology
- **Packaging team**
  - – Architect a producible, extensible, modular design compatible with infrared detector arrays
- **High Speed Optoelectronics Team**
  - – Design an optoelectronic high-speed digital interface for moving data from the focal plane to an external processor

Approach: Multi-disciplinary Research



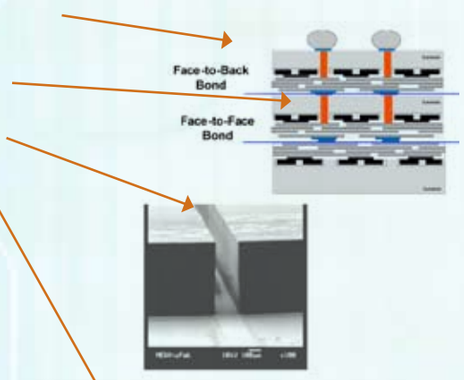
HTS Grand Challenge will lay the foundation to produce large, fast sampling FPAs

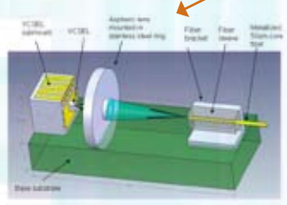


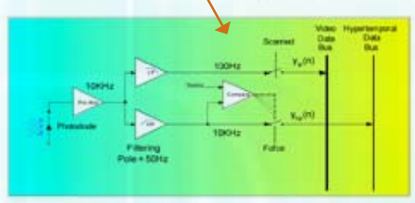
Key Aspects of Architecture
- – Modular
  - 4-side abutment
- – Vertically integrated chip stack allows significant signal processing per pixel
- – High Speed optical data interface
- – Wafer scale motherboard provides electrical and mechanical integration
- – Visible through SWIR response

Relevant Technologies in Design or Development

- **3D Silicon integrated circuit stacking**
- **Bulk Si through–wafer vias**
- **Precision Silicon Die Singulation**
- **Mixed Signal Circuit Design**
- **Optical interconnect integration**

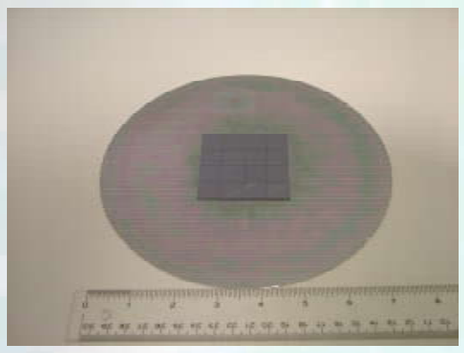


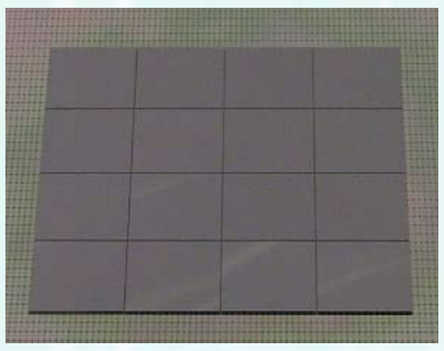




FPA Tiling Development

- **Daisy chain test vehicles**
  - – 4 x 4 grid of 15.36mm die (Same size as 2Kx2K, 30um pixel FPA)
  - – Tiles placed with 10 micron +/- 1 micron gap
  - – Each chain has 21,376 interconnections
  - – There are 64 loopback chains and 64 straight across chains on the entire wafer - 2.7 million layer- to- layer interconnects





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