

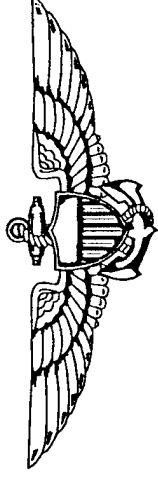
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RASTER

Realistic Analysis and Simulation Tools for EO and IR

Naval Science and Technology

Jeffrey Noel

EO and Special Mission Sensors

NAWC AD 4.5.6

Mien Wann, NAWC AD

Harvey Sokoloff, NAWC AD

Steve Campana, Sofia Monawer, Megan McGovern, TRW

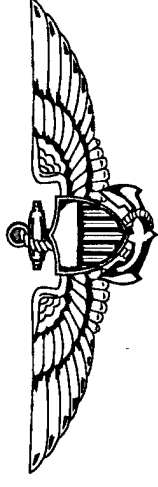
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NAVAL AIR SYSTEMS COMMAND

J. Howard

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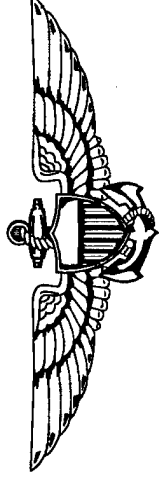
Outline



- Explain Infrared Systems
- Discuss Modeling and Simulation
- Introduce RASTER Concept
- RASTER Components
- Parametric Model Outputs
- Computer Generated Imagery Output
- Brief Demonstration
- Summarize



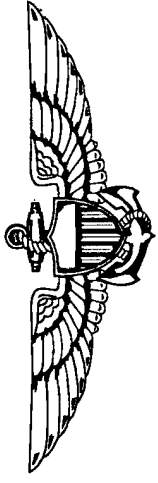
Infrared System



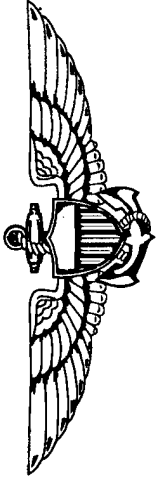
- Provides an Image to operator using thermal “heat” energy at different wavelengths such as 3-5 um or 8-12 um
- Used during Night and Low Light operations
- Applications are typically Targeting and Reconnaissance
- Systems Referred to as “FLIR” Forward Looking Infrared



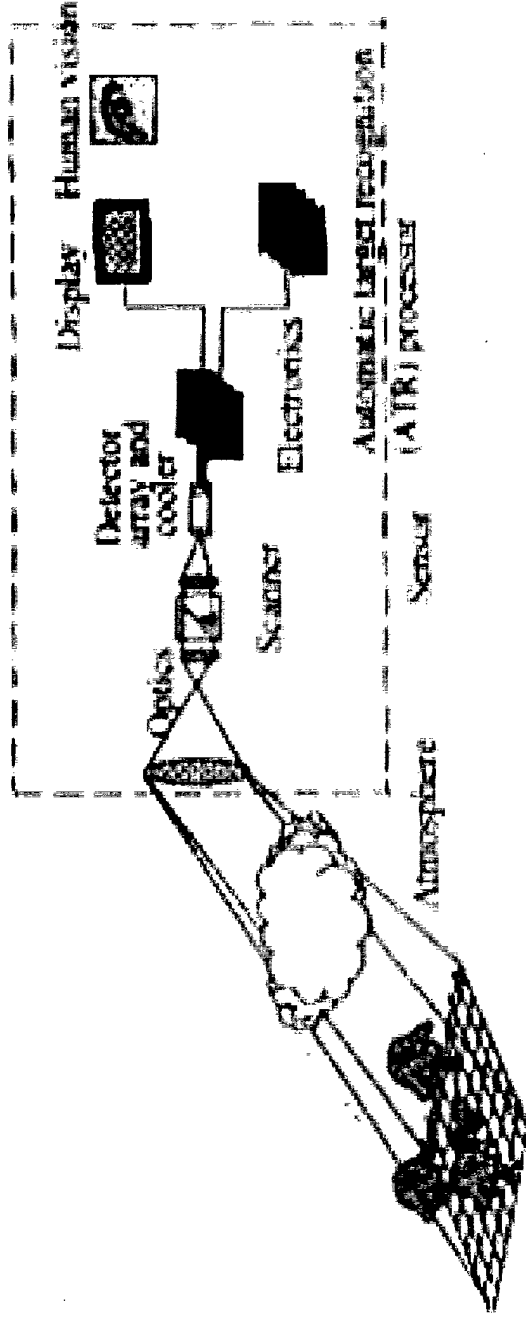
Why Simulate Infrared Systems?



- How far you can see Target?
 - Standoff Recognition Range
- How well you can detect or recognize?
 - Probability of Detection or Recognition P_D or P_R
- How sensor performs in different environments?
 - Atmospheric Attenuation
- How Target Signature effects performance?
 - Target to Background Temperature Contrast
- How Design Parameters Impact Performance?
 - Size of System, Physical Constraints, Cost



IR Sensor System Model Components

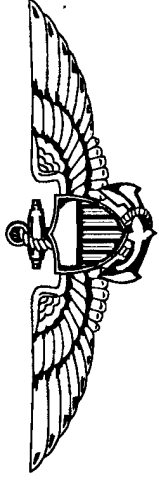


Targets and background



RASTER Concept

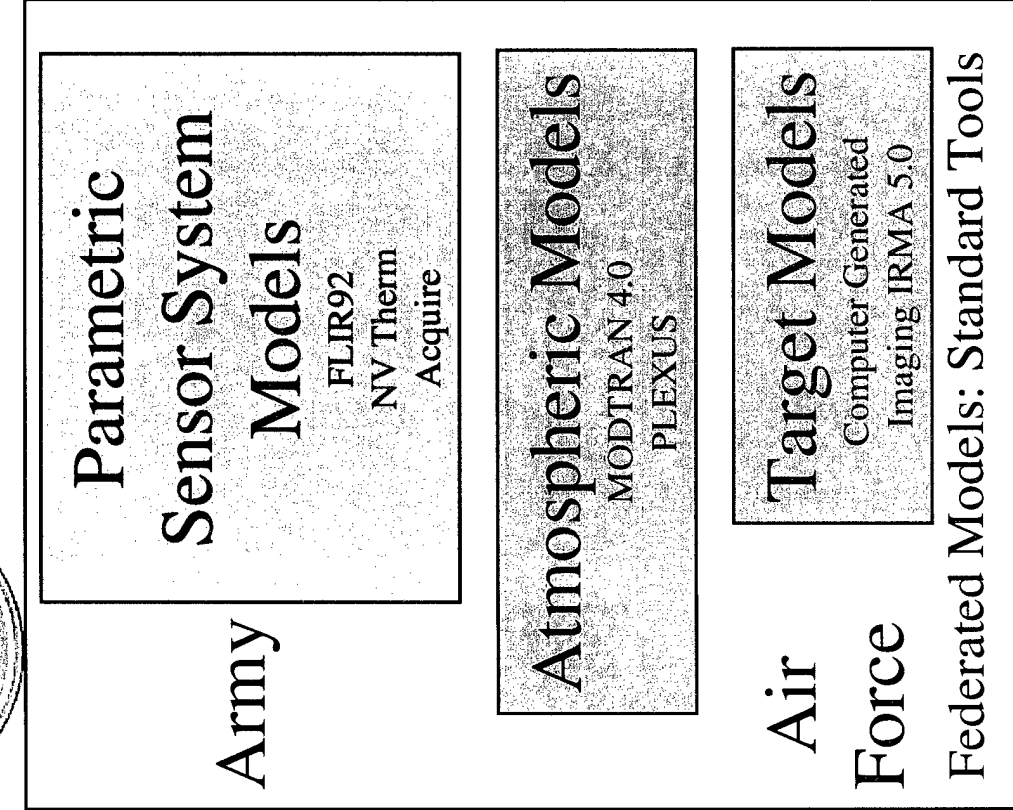
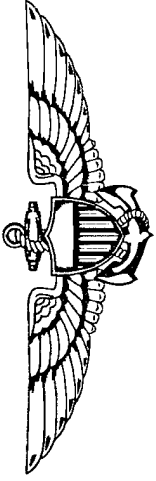
Realistic Analysis and Simulation Tools for EO and IR



- RASTER Simulation Objective
 - Augment analytical parametric models with simulated “synthetic” sensor output imagery
 - Establish a comprehensive integrated hierarchy of EO/IR sensor models and simulation.
- Approach
 - Collect Standard “Off-The-Shelf” Models and Targets
 - Apply Specific Models Appropriately
 - Integrate Models using TRW-ExFLIR Shell
 - Adapt Parametric and Signature Models to use common inputs, outputs and generate required files
 - Generate Synthetic IR Imagery and display



RASTER Approach



Navy/TRW

Synthetic
Computer
Generated
Image
Output

Integrate

EXFLIRPM
by TRW

Simplify

Automate Data Flow Process

Adapt

Common In/Outputs
Shared by models

Improved Imagery Simulation "Toolkit"

RASTER

Powered by EXFLIRPM

Target Models

Computer Generated
Imaging IRMA 5.0

Parametric
Sensor System
Models

FLIR92
NV Therm
Acquire

Atmospheric Models

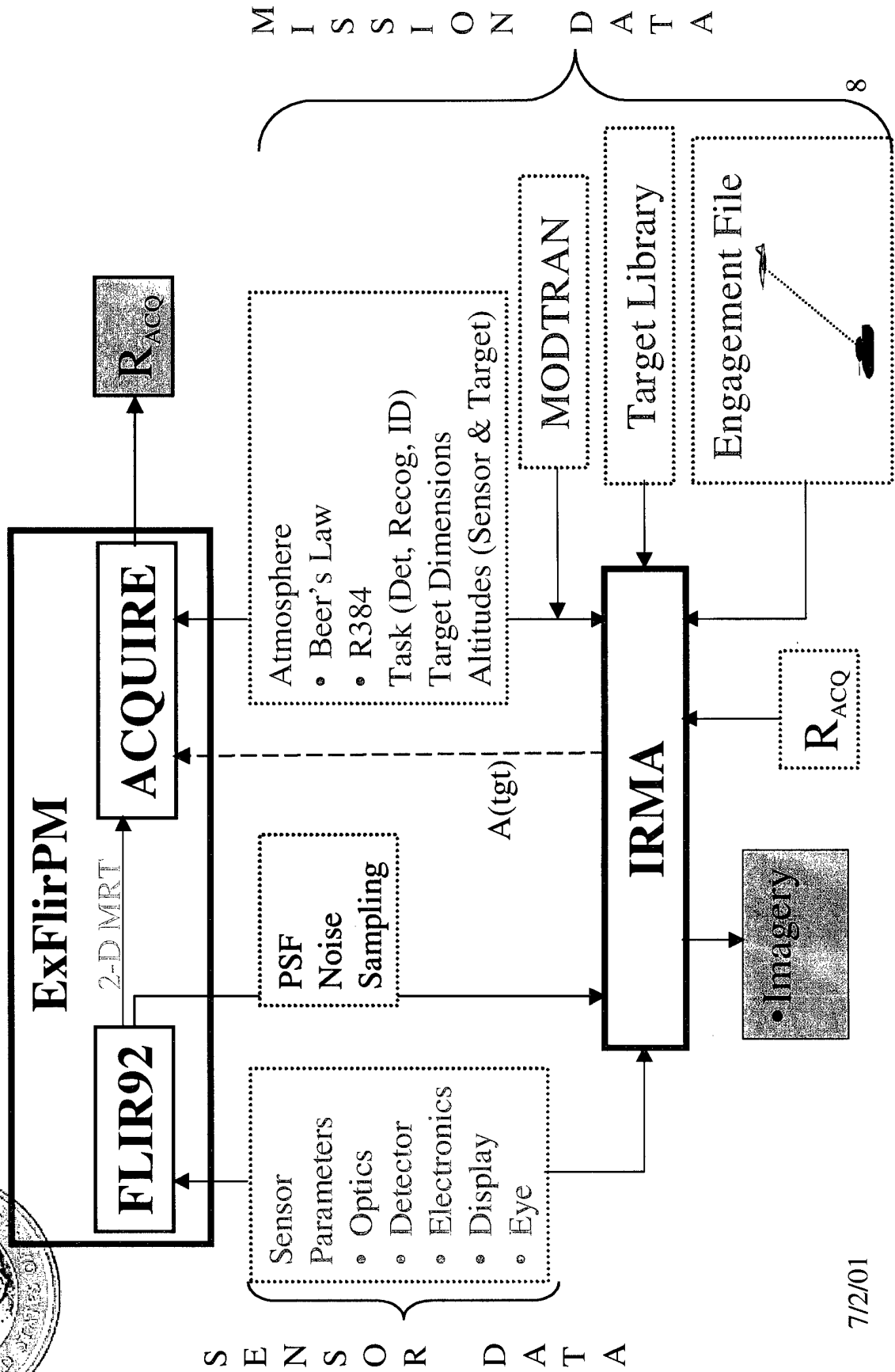
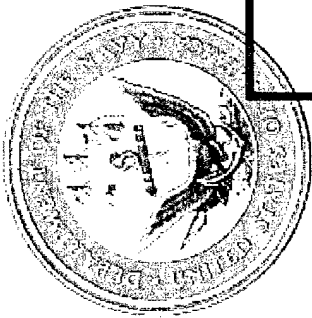
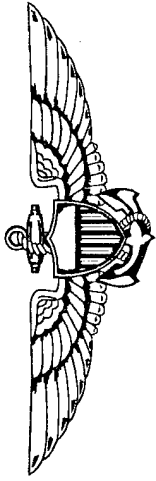
MODTRAN 4.0
PLEXUS

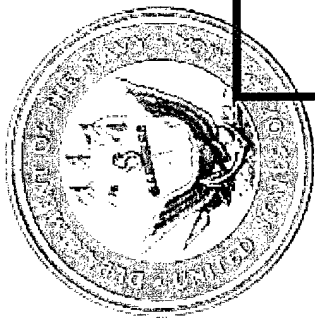
Army

Air
Force

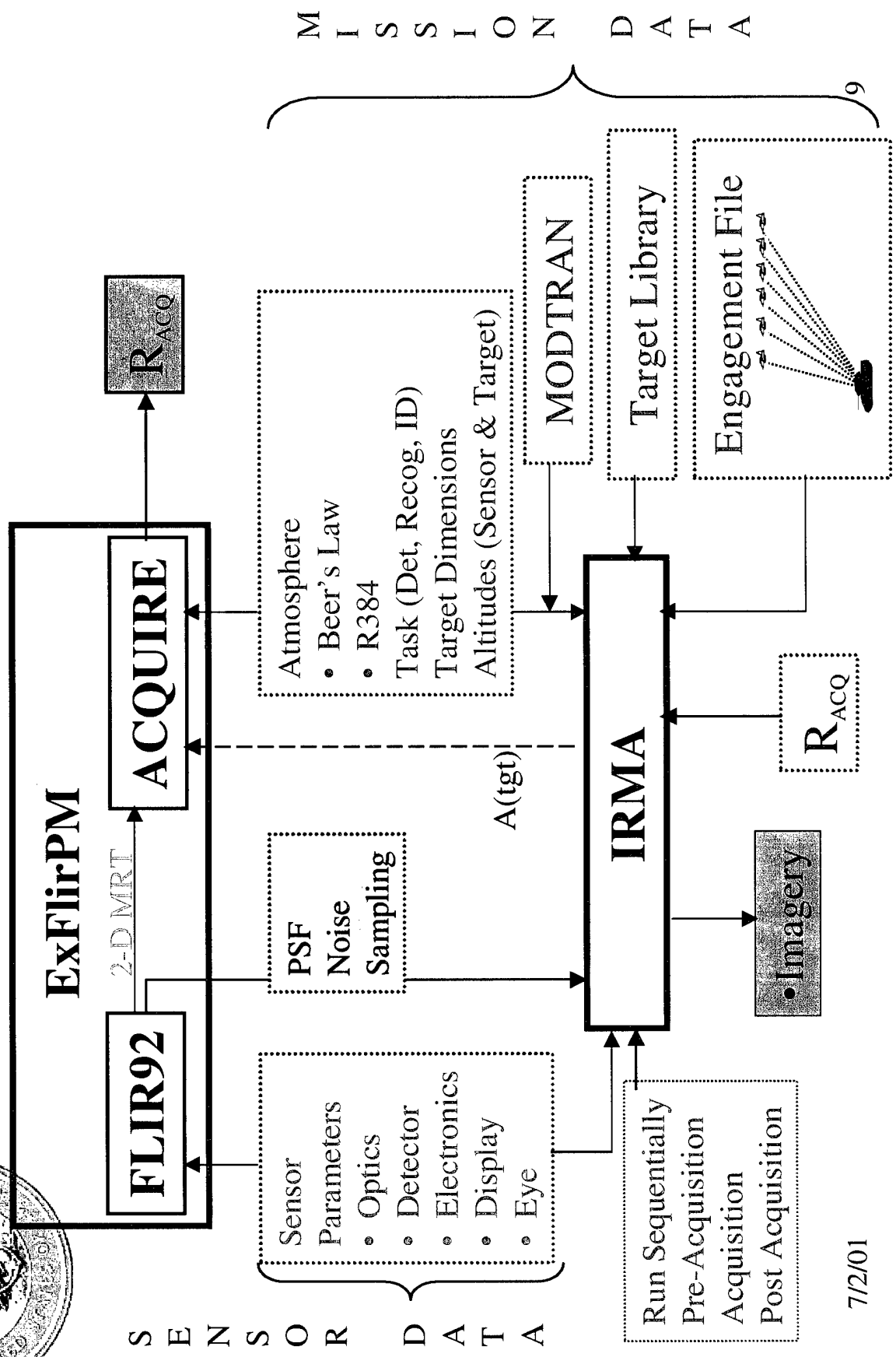
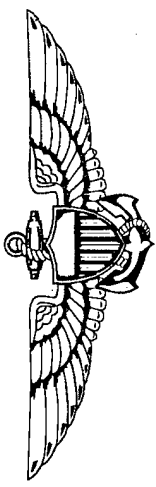
Federated Models: Standard Tools

RASTER



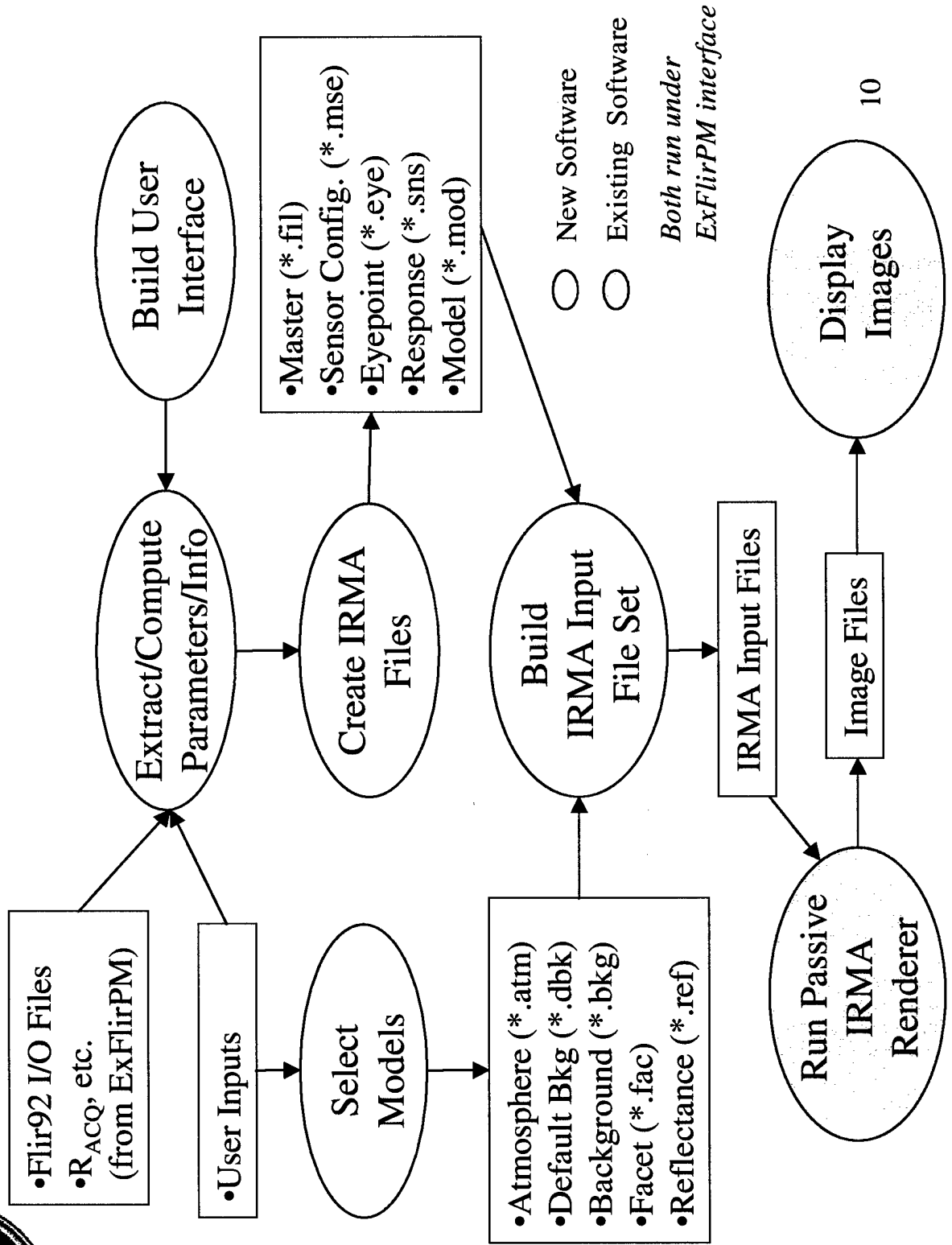
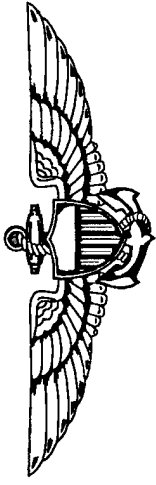


Sequential RASTER



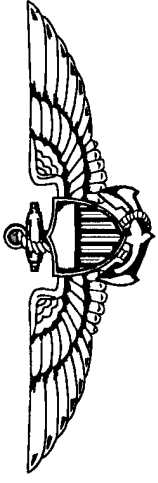


RASTER Process Diagram





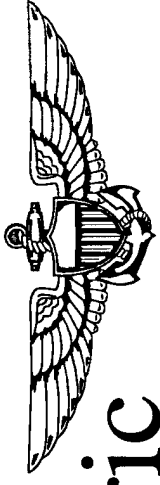
RASTER Software



Interfaces

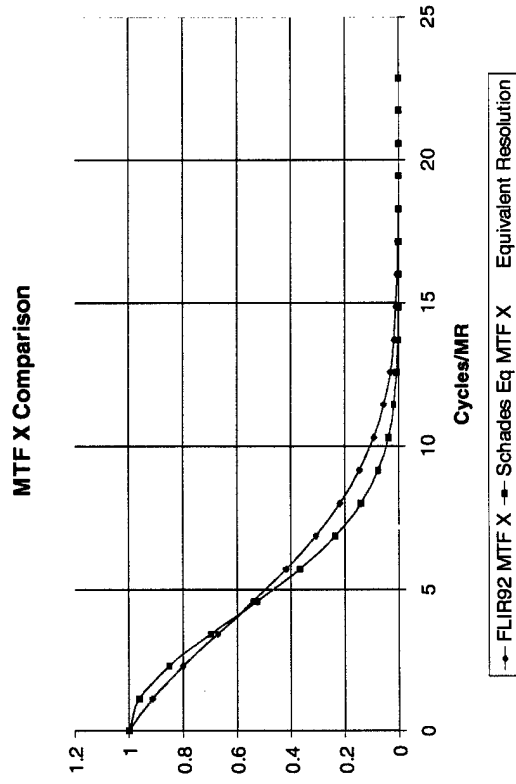
- GUI within ExFlirPm (Excel)
- Written in VBA (Visual Basic for Applications)
- Parameters/Info Extraction/Computation
 - Written in VBA, AWK, and DOS Script
- Model Selection
 - Written in VBA and AWK
- Creation of IRMA Files
 - Written in AWK
- Building IRMA Input File Set
 - Written in AWK and DOS Script
- IRMA Passive Renderer
 - Use IRMA Existing Software Module
- Image Display
 - Use PC Version of SAOimage

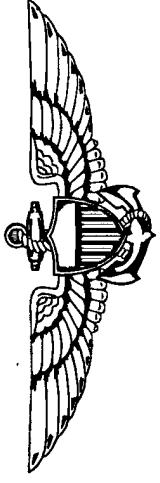
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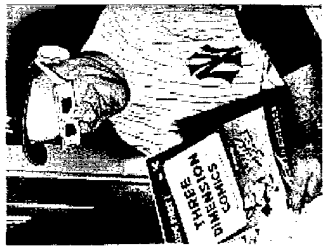
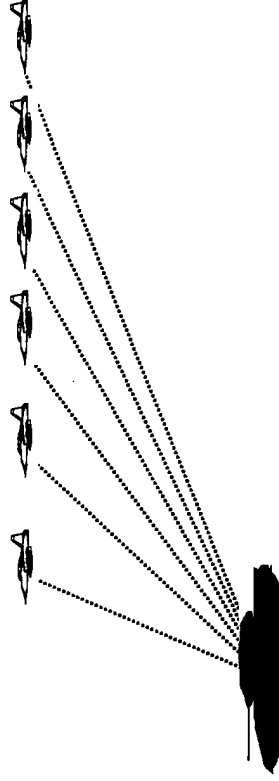
Examples of Parametric Simulation Results

- Noise NETD ~20mK
- Resolution System MTF
- Range for 90% P_R ~3 nm
- Range for 50% P_R ~5 nm
- Atmospheric Trans:0.8/km
- Target Contrast 2 deg
- Target Projected Area 4 m²



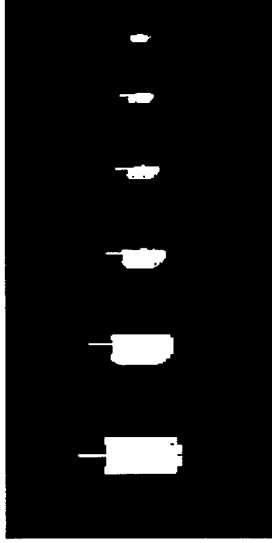


Value of Synthetic Imagery

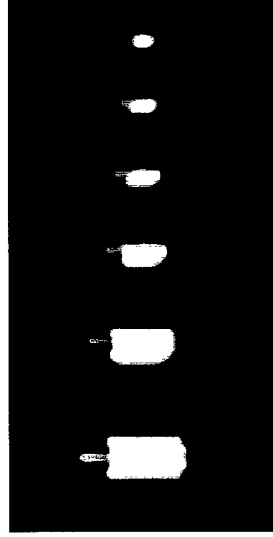


“You can observe a lot just by watching”

Yogi Berra



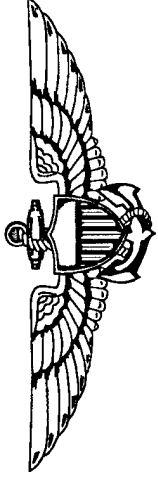
Tank Target
Signature
Simulation



Synthetic
Imagery with
some sensor
effects



Software Demonstration

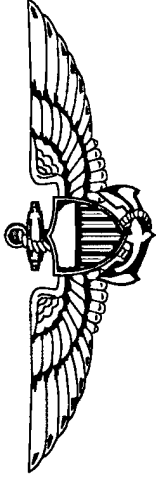


- Demo of RASTER

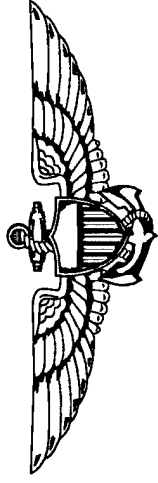


RASTER

Summary



- RASTER benefits are being realized by Navy.
 - Assembly of existing tools has familiarized engineers with existing DOD modeling capabilities.
 - Value of Physics Based Computer Generated Imagery is intuitive although not a panacea for all simulation
 - Using Microsoft Excel platform will improve exposure of complicated models to analysts
 - Elements of RASTER will have direct applicability for aircrew training as well as mission planning.
 - Related Simulation Efforts:
 - » DARPA SenSim Effort, JRM Inc
 - » F/A-18 ATFLIR Fleet Innovation Program
 - » Integrated Facility for Imaging System Simulation



Backup

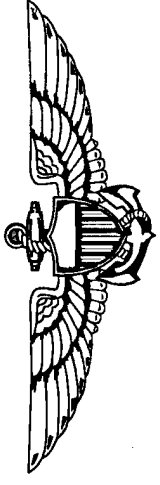
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16



IRMA Model

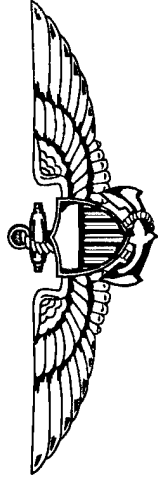
Air Force Research Modeling Tool



- IRMA is a software package that models the output of sensors commonly used in state of the art seekers.
- Passive model produces synthetic imagery to match that produced by passive sensor
- Image generator produces synthetic imagery of 3-D scenes simulating what a sensor would detect
- Simulation Capabilities Include:
 - Emitted radiation
 - Diffuse and specular scattering
 - Atmospheric path radiance
 - Path transmittance
 - Sensor spatial effects
 - Motion Simulation(tgt&back)
 - Sensor spectral effects



PLEXUS



Phillips Laboratory Expert Unified and Software

- PLEXUS is an expert system based, commercial grade package that provides single point access to atmospheric and celestial optical background codes developed by the Air Force Phillips Laboratory, Geophysics Directorate to predict and assess the impact of radiance backgrounds on electro-optic (E-O) systems.
- A non-interactive version (PLEXUS 3.0NI) for support of large scale simulations on UNIX platforms and Windows NT 4 is planned.
- The current version of PLEXUS is 2.1b. It has the following Phillips Laboratory, Geophysics Directorate optical background codes integrated into the architecture:
 - MODTRAN 3 Version 1.5, dated April 96
 - SHARC3 dated December 93 with auroral patch dated March 96
 - FASCODE3P dated March 97 with the HITRAN96 database
 - SAG1 dated December 93
 - CBSDD (Version 3.0 installed in PLEXUS 3.0)