**A. Mission Description**

Divided into two broad project areas, this program develops technologies to enable the continued superiority of sensors from space and aerial platforms. The first project develops and demonstrates advanced technologies for electro-optical (EO) sensors, radar sensors and electronic counter-countermeasures (ECCM), and components and algorithms. The second project develops and demonstrates radio frequency (RF) and EO sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2001, Congress added $4.5 million for Hyperspectral System Development (High Altitude), $3.5 million for the Integrated Demonstrations and Applications Laboratory (IDAL) Infrared (IR) Simulator and Radio Frequency (RF) and IR Integration, and $10.5 million for the National Radar Signature Production and Research Capability.

**B. Budget Activity Justification**

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.
RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

<table>
<thead>
<tr>
<th>BUDGET ACTIVITY</th>
<th>PE NUMBER AND TITLE</th>
<th>0603203F Advanced Aerospace Sensors</th>
</tr>
</thead>
</table>

C. Program Change Summary ($ in Thousands)

<table>
<thead>
<tr>
<th></th>
<th>FY 2000</th>
<th>FY 2001</th>
<th>FY 2002</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous President's Budget (FY 2001 PBR)</td>
<td>37,948</td>
<td>28,311</td>
<td>29,714</td>
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<tr>
<td>Appropriated Value</td>
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<td>46,811</td>
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<tr>
<td>Adjustments to Appropriated Value</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Congressional/General Reductions</td>
<td>-2</td>
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<tr>
<td>b. Small Business Innovative Research</td>
<td>-905</td>
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<tr>
<td>c. Omnibus or Other Above Threshold Reprogram</td>
<td>-785</td>
<td></td>
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<tr>
<td>d. Below Threshold Reprogram</td>
<td>44</td>
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<tr>
<td>e. Rescissions</td>
<td>-397</td>
<td>-430</td>
<td></td>
<td>26,095</td>
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<tr>
<td>Adjustments to Budget Years Since FY 2001 PBR</td>
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<td></td>
<td></td>
<td>26,095</td>
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<tr>
<td>Current Budget Submit/FY 2002 PBR</td>
<td>36,360</td>
<td>46,381</td>
<td>55,809</td>
<td>TBD</td>
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</table>

Significant Program Changes:
Changes to this program since the previous President's Budget reflect the transfer of work to align projects with the Air Force Research Laboratory organization.
**A. Mission Description**

This project develops and demonstrates aerospace sensor technologies for manned and unmanned platforms, including electro-optical (EO) sensors, radar sensors, components and algorithms, and electronic counter-countermeasures (ECCM) for radars. It provides aerospace platforms with the capability to precisely detect and target both airborne (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Project activities include developing both complete sensor capabilities as well as advanced component technologies. Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions, especially the ability to counter improvements in camouflage, concealment, and deception techniques.

(U) **FY 2000 ($ in Thousands)**

(U) $1,618 Developed integrated EO sensor technologies to search, detect, locate, and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. Completed fabrication and initiated flight test of an EO sensor that operates in day or night across multiple bands.

(U) $2,175 Developed EO sensor technologies to detect and locate deep hide targets from high altitudes. Collected infrared sensor model validation data. Created hyperspectral imaging/fusion algorithms.

(U) $2,122 Developed radar signal processing techniques to mitigate clutter and interference and improve detection and tracking of difficult targets. Developed adaptive processing for fighter detection of low-observable targets, demonstrating improved radar performance via enhanced antenna implementation. Developed integrated processing methods for improved ground target detection and tracking.

(U) $3,264 Developed radio frequency (RF) sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or obscured by deceptive techniques. Flight tested image formation processing and automatic target detection.

(U) $1,494 Developed technology to lower life cycle costs of radar systems. Laboratory tested low-cost digital receivers and sensor components. Evaluated space-based apertures using micro-electro-mechanical phase shifters. Demonstrated a millimeter wave array for high-altitude unmanned aerial vehicles.


(U) $12,176 Total
### A. Mission Description Continued

#### FY 2001 ($ in Thousands)

- **$1,894** Develop integrated electro-optical (EO) sensor technology to search, detect, locate, and identify air and ground targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. Optimize sensor design and perform utility assessments for affordable integrated targeting capability.

- **$7,665** Develop EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace intelligence, surveillance, and reconnaissance (ISR) applications. Complete critical signature data collection experiments to determine performance parameters for day/night hyperspectral sensors. Fabricate a hyperspectral imaging sensor for high altitude reconnaissance aircraft.

- **$1,908** Develop advanced radar signal processing techniques to mitigate clutter and jamming interference and improve detection and tracking of difficult targets. Demonstrate ability to detect slow moving airborne and ground targets from an airborne platform.

- **$2,470** Develop and demonstrate the radio frequency (RF) sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques. Perform flight test demonstration of foliage penetration RF sensor and real-time image formation algorithms.

- **$874** Develop technology to lower life cycle costs of radar systems. Develop low-cost, lightweight antennas using micro-electro-mechanical phase shifters for aerospace surveillance and strike radar applications.

- **$2,180** Develop advanced EO sensor technology for non-cooperative target identification. Flight test eye-safe sensor. Perform necessary modifications prior to sensor transition.

- **$825** Develop advanced multi-function sensor component technologies for radar, electronic warfare, navigation, and communications applications. Demonstrate and evaluate affordable, high performance RF circuits and packaging technologies for use in phased array transmit/receive modules on manned and unmanned platforms. (In FY 2000, this work was performed in this PE, Project 69CK.)

- **$1,109** Develop advanced RF photonic signal control and distribution technologies for phased array apertures. Demonstrate and evaluate photonic beamforming. Design and fabricate true-time-delay photonic technology for phased array antennas used in ISR applications. (In FY 2000, this effort was conducted under PE 0603726F, Project 2863.)

- **$18,925** Total

#### FY 2002 ($ in Thousands)

- **$3,452** Develop integrated electro-optical (EO) sensor technology to search, detect, locate, and identify air and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception. Design and begin demonstrating active and passive sensor components of an affordable, integrated targeting capability.

- **$3,720** Develop EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace intelligence, surveillance, and...
UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)  

Project 665A  

Page 5 of 12 Pages  

Exhibit R-2A (PE 0603203F)  

UNCLASSIFIED

A. Mission Description Continued

FY 2002 ($ in Thousands) Continued

- Develop advanced radar signal processing techniques to mitigate clutter and jamming interference and improve detection and tracking of difficult targets. Design processing architecture for evaluation of multi-dimensional adaptive processing techniques. Demonstrate these techniques for multi-mission aerospace radar applications.

- Develop and demonstrate the radio frequency (RF) sensor techniques required to detect, track, and target high-value, time-critical targets that are obscured by foliage or concealed through deceptive techniques. Demonstrate concealed target detection through analysis of flight test data. Demonstrate detection range improvements for low-observable targets.

- Develop advanced EO sensor technology for non-cooperative target identification. Complete design and begin development of multi-function laser for air and ground target identification.

- Develop advanced multi-function sensor component technologies for radar, electronic warfare, navigation, and communications applications. Initiate evaluation of very high density two-dimensional and three-dimensional interconnects for phased array transmit/receive modules on manned and unmanned platforms. Finalize testing of a multi-chip module implementation of the monobit receiver for electronic warfare applications. Develop advanced RF photonic signal control and distribution technologies for phased array apertures.

- Develop and demonstrate advanced modular, sharable digital RF sensor technologies for aerospace sensor suites performing ISR applications. Demonstrate a multi-channel radar digital receiver with channel match greater than 60dB and jammer cancellation. (In FY 2001, this work was performed in PE 0603253F, Project 2735.)

- Develop technologies to maximize Global Positioning System (GPS) jam resistance, positional accuracy, and exploitation techniques to improve offensive and defensive combat capabilities. Design advanced GPS M-Code technology. Develop geo-registration and precise target location technology supporting multi-sensor and distributed sensor integration. (In FY 2001, this work was performed in PE 0603253F, Project 666A.)

B. Project Change Summary

Not Applicable.
C. Other Program Funding Summary ($ in Thousands)

Related Activities:
- PE 0602204F, Aerospace Sensors.
- PE 0602111N, Weapons Technology.
- PE 0602232N, Space and Electronic Warfare (SEW) Technology.
- PE 0604249F, LANTIRN Night Precision Attack.
- PE 0603270F, Electronic Combat Technology.

An MOA has been established between AFRL and DARPA to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments including deception, camouflage, concealment, and deep hide.

This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

D. Acquisition Strategy
Not Applicable.

E. Schedule Profile
Not Applicable.
A. Mission Description
This project develops and demonstrates military specific microwave, microelectronic, and photonic devices, tools, and components to improve performance, reliability, and affordability of aerospace radar, communications, and electronic counter-countermeasure systems for both retrofit and new system applications. Results provide the warfighter with improved sensor capabilities in terms of increased situational awareness, higher accuracy detection and tracking of targets and threats at longer ranges, and more precise weapon employment. This project develops electronics technologies unavailable from commercial sources and includes development of: aerospace radar monolithic solid state transmit/receive modules; high-speed analog-to-digital converters; photonic processing techniques; high reliability electronics power distribution; microwave and microelectronics packaging and interconnect techniques; and radio frequency (RF) photonic distribution subsystems.

FY 2000 ($ in Thousands)
$429 Developed advanced multi-function sensor electronics. Developed affordable, high performance RF circuits and packaging technologies for use in phased array transmit/receive modules on manned and unmanned platforms.
$330 Performed application trade studies for space-based photonics RF signal distribution, including photonic beamforming for Global Positioning System (GPS) applications.
$759 Total

FY 2001 ($ in Thousands)
$0 Effort transferred to this PE, Project 665A.
$0 Total

FY 2002 ($ in Thousands)
$0 No Activity.
$0 Total

B. Project Change Summary
Not Applicable.
C. Other Program Funding Summary ($ in Thousands)

Related Activities:
- PE 0602204F, Aerospace Sensors.
- PE 06032070F, Electronic Combat Technology.
- PE 0603739E, Electronic Manufacturing Technology.
- PE 0603706E, Microwave/Millimeter Wave Integrated Circuits.

This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

D. Acquisition Strategy

Not Applicable.

E. Schedule Profile

Not Applicable.
### A. Mission Description

This project develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency (DARPA) and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitional to new and existing weapon systems.

### FY 2000 ($ in Thousands)

<table>
<thead>
<tr>
<th>Project 69DF</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2,470</td>
<td>Developed advanced situational technologies for rapid detection, location, and prosecution of time-critical targets. Demonstrated ground station fusion of synthetic aperture radar and signals intelligence. Developed on-board/off-board data and image fusion algorithms.</td>
</tr>
<tr>
<td>$2,719</td>
<td>Developed and demonstrated real-time information-in-the-cockpit technologies. Flight demonstrated and simulated real-time route replanning and retargeting for stealth strike platforms. Developed real-time retargeting algorithms for special operation forces.</td>
</tr>
<tr>
<td>$1,490</td>
<td>Developed and evaluated radar automatic target recognition (ATR) algorithms for tracking moving ground targets. Evaluated radar algorithms for tracking moving ground target. Reduced transition risk by planning affordable upgrades to strike and reconnaissance platforms.</td>
</tr>
<tr>
<td>$1,127</td>
<td>Developed target recognition concepts using hyperspectral imaging and other candidate sensor inputs to determine requirements for ATR and target/background phenomenology efforts. Built algorithms using hyperspectral imaging data.</td>
</tr>
<tr>
<td>$2,777</td>
<td>Tested and integrated DARPA multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance functions.</td>
</tr>
<tr>
<td>$1,852</td>
<td>Developed advanced tactical targeting technology in conjunction with DARPA for suppression of enemy air defenses. Conducted</td>
</tr>
</tbody>
</table>
### A. Mission Description Continued

#### FY 2000 ($ in Thousands) Continued

- **$2,073** Developed air-to-ground radar imaging technology for all-weather detection and identification of ground targets.
- **$8,917** Developed Integrated Demonstrations and Applications Laboratory (IDAL) testbed for maturing aerospace sensor technologies through hardware-in-the-loop simulation. Created the capability to generate high fidelity emissions that simulate real battlespace threat systems, allowing warfighters to affordably evaluate sensor technologies under realistic combat conditions.
- **$23,425** Total

#### FY 2001 ($ in Thousands)

- **$2,054** Develop advanced situational awareness technologies for rapid detection, location, and prosecution of time-critical targets. Demonstrate algorithms for multisensor fusion of on- and off-board data and images.
- **$2,798** Develop and demonstrate technologies for real-time information in- and out-of-the-cockpit for improved situational awareness. Complete route replanning simulations. Continue to develop real-time retargeting algorithms for special operation forces applications.
- **$1,810** Develop and evaluate radar automatic target recognition (ATR) algorithms for tracking and identifying moving and stationary ground targets. Conduct risk reduction activities to improve affordability and smooth transition of technology via planned sensor upgrades to strike and reconnaissance platforms.
- **$1,136** Develop target recognition concepts using hyperspectral imaging data and other candidate sensor inputs to determine requirements for ATR and target/background phenomenology efforts. Evaluate algorithms using hyperspectral imaging data.
- **$2,542** Continue testing and integrating Defense Advanced Research Projects Agency (DARPA) multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance missions.
- **$3,116** Develop advanced tactical targeting technology in conjunction with DARPA for suppression of enemy air defenses. Optimize targeting algorithms and techniques. Modify brassboard units that triangulate threat emitter position and provide targeting for precision guided munitions. (In FY 2002, this effort transfers to PE 0603270F, Project 2432.)
- **$3,500** Develop IDAL technology. Perform integration of infrared (IR) and RF sensors to simulate battlefield-condition sensor operation at dramatically reduced cost.
- **$10,500** Develop a National Radar Signature Production and Research Capability (RCAS). Develop computer modeling and simulation of aircraft radar signature libraries necessary to discriminate friend, foe, and neutral targets.
- **$27,456** Total
A. Mission Description Continued

FY 2002 ($ in Thousands)

$2,843 Develop advanced global awareness and precision engagement automated targeting technologies for rapid detection, location, and prosecution of time-critical targets. Integrate modeling, simulation, and analysis testbed to demonstrate automatic target recognition (ATR) and information fusion algorithms for time-critical targeting, emphasizing the difficult targeting missions where weather, terrain, foliage, camouflage, or deception techniques obscure or conceal the targets of interest.

$3,730 Develop common, open system technologies for integrating real-time information in- and out-of-the-cockpit (RTIC/RTOC) to improve aircrew situational awareness, target nomination, and target engagement capabilities. Demonstrate a capability to fuse all-source threat, target, and survivor location data for use on special operations forces aircraft.

$2,309 Develop and evaluate radar ATR algorithms for tracking and identifying moving and stationary ground targets. Continue demonstration of affordable risk reduction for transition via planned sensor upgrades to strike and reconnaissance platforms.

$1,421 Develop ATR solutions using hyperspectral imaging data and other candidate sensor inputs. Develop target and background phenomenology technology to recognize and identify targets using hyperspectral imaging data.

$3,553 Continue testing and integrating Defense Advanced Research Projects Agency multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test facility for application to intelligence, surveillance, and reconnaissance missions. Test and assess these automated decision aids for cost versus capability against specific air and surface targeting mission requirements.

$22,750 Develop technology to detect and identify targets under trees. Design and fabricate a very-high frequency (VHF) foliage penetration radar. Develop and implement VHF radar change detection algorithms for robust target detection with a low false alarm rate. Perform VHF radar data collections for algorithm development and foliage penetration characterization. Develop imagery exploitation algorithms for target identification sensor fusing techniques. Perform high fidelity modeling of the VHF radar, change detection capability, data fusion process, and weapon effectiveness. Develop integration plans for a warfighter-selected operational platform.

$36,606 Total

B. Project Change Summary

Not Applicable.

C. Other Program Funding Summary ($ in Thousands)

Related Activities:

PE 0602204F, Aerospace Sensors.

PE 0603253F, Advanced Sensor Integration.

PE 0603762E, Sensor and Guidance Technology.
C. Other Program Funding Summary ($ in Thousands)

- PE 0603270F, Electronic Combat Technology
- Theater Missile Defense System Program Office.
- Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.
- This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

D. Acquisition Strategy

Not Applicable.

E. Schedule Profile

Not Applicable.