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

DATE: February 2003

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	79,389	76,743	75,577	84,110	96,231	99,107	98,548	100,945	Continuing	TBD
2002	Electronic Component Technology	19,675	14,592	11,874	12,780	16,355	16,586	16,961	17,335	Continuing	TBD
2003	EO Sensors & Countermeasures Tech	13,602	14,028	15,670	15,739	15,975	16,461	16,836	17,206	Continuing	TBD
4916	Electromagnetic Tech	8,807	7,940	9,255	9,737	10,075	10,475	10,898	11,334	Continuing	TBD
5016	Photonic Component Technology	0	2,242	2,914	3,334	2,405	2,436	2,506	2,576	Continuing	TBD
5017	RF Processing for ISR Sensors	0	9,078	6,700	7,911	7,886	7,482	7,674	7,867	Continuing	TBD
6095	Sensor Fusion Technology	12,568	12,407	12,235	14,071	15,948	16,590	16,961	17,328	Continuing	TBD
7622	RF Sensors & Countermeasures Tech	24,737	16,456	16,929	20,538	27,587	29,077	26,712	27,299	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	Continuing	TBD

Note: In FY 2002, work performed under PE 0602702F, Project 4600, moved to this PE, Project 4916. Apparent project ramps are due to realignment of the projects within the Air Force Research Laboratory organization. Project realignment did not affect work planned for the overall program element or the budget topline. In FY 2003, space unique tasks in this PE, Projects 2002, 6095, and 7622, transferred to PE 0602500F, Projects 5028 and 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing 'anytime, anywhere' surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical aerospace sensor technologies for a variety of offensive and defensive uses; 3) RF antennas and associated electronics for

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(U) A. Mission Description Continued

airborne surveillance, together with active and passive electro-optical sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems. Note: In FY 2003, Congress added $1.0 million for Wireless Surveillance of Hostile Threats, $1.0 million for Advanced Fourier Transform-Infrared Gas Analysis, $1.0 million for Phased Array Antenna and Control System, and $1.3 million for Air Force Research Laboratory Information and Sensors Directorate.

(U) B. Budget Activity Justification

This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

(U) C. Program Change Summary ($ in Thousands)

		FY 2002	FY 2003	FY 2004	Total Cost
(U)	Previous President's Budget	80,847	75,799	80,380	
(U)	Appropriated Value	81,149	80,099		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-302	-3,181		
	b. Small Business Innovative Research	-1,070			
	c. Omnibus or Other Above Threshold Reprogram		-175		
	d. Below Threshold Reprogram				
	e. Rescissions	-388			
(U)	Adjustments to Budget Years Since FY 2003 PBR			-4,803	
(U)	Current Budget Submit/FY 2004 PBR	79,389	76,743	75,577	TBD

(U) Significant Program Changes:

None.

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BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT: 2002

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2002 Electronic Component Technology	19,675	14,592	11,874	12,780	16,355	16,586	16,961	17,335	Continuing	TBD

Note: In FY 2003, efforts in photonic component technology moved from this project into this PE, Project 5016. Also in FY 2003, space unique tasks in this project transferred to PE 0602500F, Projects 5028 and 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project focuses on generating, controlling, receiving, and processing electronic signals for radio frequency (RF) sensor aerospace applications. The enabling technologies developed under this project will be used for intelligence, surveillance, reconnaissance (ISR), electronic warfare (EW), and precision engagement. The technologies developed include: solid state power devices and amplifiers; low noise and signal control components; high-temperature electronics; signal control and distribution; signal processing; multi-function monolithic integrated circuits; high-speed analog-to-digital and digital-to-analog mixed mode integrated circuits; power distribution; multi-chip modules; and high density packaging and interconnect technologies. This project also designs, develops, fabricates, and evaluates techniques for integrating combinations of these electronic component technologies. The project aims to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower power dissipation, higher reliability, and improved performance. The device and component technology developments under this project are military unique; they are based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, communications, EW, navigation, and smart weapons.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $3,071 Developed compact, affordable, multi-function receiver and phased array components for radar, EW, and other ISR sensors. Demonstrated Gallium Arsenide (GaAs), Indium Phosphide (InP), and silicon-on-insulator RF components for bench-level evaluation of radar and EW digital receiver modules. Developed a brassboard low-power (< 1.0W) analog-to-digital converter and delivered the converter for testing in a space-qualified silicon package. Completed the study and design phase of a multi-mode/multi-function digital receiver prototype module, and completed a feasibility trade study on performing wideband direct digital synthesis from aerospace platforms.

(U) $3,192 Developed microwave technologies for advanced RF apertures and phased array antennas used in military ISR sensors. Developed and demonstrated robust components for L-band and X-band transmitters and receivers that operate with limited environmental controls. The components are greater than 60% efficient with no active cooling, provide 20 Watts of output power, and are designed for radiation tolerance to 1 Mrad and greater than 200 degrees Celsius operating temperature.

(U) $4,057 Developed packaging and integration technologies for high performance aerospace RF sensor components. Demonstrated ten-fold cost reduction in an aerospace 20 GHz transmitter and a Ku-to -X-Band down-converter using low-cost packaging techniques. Developed a novel, flexible

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

membrane to enable an ultra lightweight transmit/receive subarray. Developed mixed signal multi-chip modules, and evaluated three-dimensional interconnects, chip coatings, and advanced design techniques to enable high density micro-electro-mechanical systems and flexible assemblies for aerospace applications.

(U) $604 Developed signal control components and techniques to meet radio frequency (RF) loss levels required for future radar, electronic warfare (EW), and intelligence, surveillance, and reconnaissance (ISR) sensors. Fabricated and characterized micro-electro-mechanical systems phase shifters for 300% improvement in RF loss performance operating over a 3:1 bandwidth.

(U) $4,070 Developed RF photonic technologies to demonstrate compact, affordable, wide bandwidth, high data rate aerospace sensors. Developed low-loss, low-voltage broadband modulators for compact digital receiver applications. Designed high-performance components for wideband phased array antennas. Investigated the integration of photonic solutions for long time delays with the micro-electro-mechanical phase shifters for short delays to increase bandwidth.

(U) $2,502 Developed innovative transmitter and receiver concepts along with the associated component technology alternatives required for an affordable space-based RF surveillance sensor system. Designed architectures that maximize predicted transmitter and receiver technology payoffs, and identified long lead-time RF sub-components required for space-based moving target indication.

(U) $991 Designed and developed Fourier Transform-Infrared spectrometric gas analysis techniques for applications in controlling reactant gases generated during the vapor phase epitaxial growth of semiconductor films on substrates. These techniques will also be used to monitor gas concentrations in nanostructure growths for electronic and optical devices, and in the development of new approaches to detecting chemical and biological agents.

(U) $1,188 Developed and conducted a proof of concept demonstration of the integration of active aperture components into flexible RF-compatible substrates. Integrating these components will enable robust chip placement on flexible phased array subassemblies for radar, EW, and communications systems.

(U) $19,675 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $3,047 Develop compact, affordable, multi-function receiver/exciter and phased array components for communications, Global Positioning System, radar, EW, and other ISR sensors. Test Gallium Arsenide and Indium Phosphide RF components (analog-to-digital converters, filters, mixers, etc.) inserted into radar and EW digital receiver modules against environment scenarios. Demonstrate a brassboard low-power (< 1.0W), silicon-on-sapphire based analog-to-digital converter and complete ground-level radiation testing in a space-qualified package. Laboratory test a

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

silicon-on-insulator mixed-signal (digital, radio frequency (RF), microwave, etc.) integrated circuit, for reconfigurable signal conversion.

(U) $2,545 Develop microwave technologies for advanced RF apertures and phased array antennas used in military intelligence, surveillance, and reconnaissance (ISR) sensors. Develop and demonstrate robust components for L-band and X-band transmitter and receiver channels that operate with limited environmental controls and under severe electromagnetic stress.

(U) $3,247 Develop integration and assembly technologies for high performance aerospace phased array sensors. Demonstrate X-band, flexible RF membrane-based sub-assemblies that enable integrating low-cost and low-mass transmitter and receiver channels at the subarray level.

(U) $2,171 Develop signal control and low-power consumption components and techniques to reduce both power loss and power consumption. These components will be required for future radar, electronic warfare (EW), and ISR sensors. Characterize and mature micro-electro-mechanical systems wideband phase shifters for extended switch lifetimes. Reduce the power consumption of low-noise amplifiers while maintaining high linearity over wide bandwidths.

(U) $1,624 Refine materials and processes for two-dimensional and three-dimensional device interconnects and component protection from the environment. Verify these interconnects and components perform on rigid, flexible, and conformal assemblies of high density mixed signal technologies (digital, analog, microwave and millimeter wave devices and components). Test interconnects and components in both packaged (non-hermetic multi-chip modules) and package-less (bare-die-chip on board) forms.

(U) $979 Develop low-temperature, high-efficiency, small-scale fuel cells to generate power for wireless micro-sensor systems that will provide 'anytime, anywhere' ISR capabilities against emerging hostile threats.

(U) $979 Demonstrate Fourier Transform-Infrared spectrometric gas analysis techniques for applications in controlling reactant gases generated during the vapor phase epitaxial growth of semiconductor films on substrates. These techniques will also be used to monitor gas concentrations in nanostructure growths for electronic and optical devices, and in the development of new approaches to detecting chemical and biological agents.

(U) $14,592 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,606 Develop compact, affordable, multi-function receiver/exciter and phased array components for communications, Global Positioning System, radar, EW, and other ISR sensors. Develop receiver architecture and components addressing issues specific to digital beamforming systems, such as multiple channel coherence of multi, digital true time delay support, channel equalization, and array calibration. Evaluate in an operational environment affordable Gallium Arsenide (GaAs) RF components (analog-to-digital converters, filters, mixers, etc.), together with the technology upgrade plan for Indium Phosphide (InP) RF components into radar and EW digital receiver modules.

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	PROJECT 2002

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

(U)	$2,298	Develop and integrate microwave technologies for advanced radio frequency (RF) apertures and phased array antennas used in military intelligence, surveillance, and reconnaissance (ISR) sensors. Develop and demonstrate the proof of concept of transmit and receive (T/R) channels that are able to withstand strong undesired electromagnetic signals.
(U)	$2,039	Continue developing integration and assembly technologies for high performance phased array sensors. Demonstrate large area (>0.5 m2) active apertures based on flexible RF membranes that lower the assembly costs and mass over conventional phased arrays by an order of magnitude.
(U)	$2,738	Develop low-power consumption components and techniques to reduce the aperture power consumption required for future radar, electronic warfare, and ISR sensors suitable for use on small, air-launched, unmanned aerial vehicles. Fabricate subarrays with T/R channels that feature a five-fold power consumption reduction while maintaining high linearity over wide bandwidths.
(U)	$1,300	Demonstrate mixed-signal receiver/processor multi-functionality on flexible arrays using advanced two-dimensional and three-dimensional interconnects, and package-less protection schemes. Verify the electrical performance of these mixed signal assemblies and validate their hermetic-like protective qualities.
(U)	$893	Evaluate the integrated tool suite in the modeling, simulation, design, and characterization environment for mixed-signal (digital, RF, microwave, etc.) component development in both advanced and emerging electronic component technologies. Laboratory test breadboard silicon-on-insulator and silicon-on-sapphire signal conversion components designed for precise positioning, navigation, and other aerospace applications.
(U)	$11,874	Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602500F, Multi-disciplinary Space Technology.
(U) PE 0603203F, Advanced Aerospace Sensors.
(U) PE 0603270F, Electronic Combat Technology.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

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	PROJECT 2002

(U) E. Schedule Profile

(U) Not Applicable.

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BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors
	PROJECT: 2003

	COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
2003	EO Sensors & Countermeasures Tech	13,602	14,028	15,670	15,739	15,975	16,461	16,836	17,206	Continuing	TBD

(U) A. Mission Description

This project determines the technical feasibility of advanced electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses. The sensor technologies under development range from the ultraviolet through the infrared (IR) portion of the spectrum. Related efforts include improvements in avionics integration, digital processing, analysis tools, and sensor architectures. One of the project's main goals is to improve EO and related technologies for the detection, tracking, and identification of non-cooperative and difficult targets, such as those obscured by camouflage. This project also develops the passive and active hyperspectral imaging sensors and algorithms needed to enable precision targeting in severe weather. These technologies are critical to future aerospace surveillance and targeting. Other project goals include advanced EO threat warning and countermeasures.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,790 Developed technology for non-cooperative identification of airborne and ground-based platforms. Conducted ground-to-air demonstration of long-range combat identification (CID) sensors. Tested coherent image processing/extraction algorithms including three-dimensional (3-D) block registration algorithms. Conducted measurements and evaluated advanced 3-D focal planes for CID application. Continued passive hyperspectral model development, validation, and performance predictions. Continued analyzing and evaluating multi-function ladar flight demonstration data for CID.

(U) $2,509 Developed optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification. Continued developing a pulsed vibration/imaging sensing system for long-range combat identification. Investigated and demonstrated critical components of a monolithic, solid state coherent ladar architecture.

(U) $3,175 Developed innovative techniques and components to target difficult objects in degraded atmospheric conditions. Began utility analysis of high altitude active sensors. Tested components for active multi-spectral imaging. Demonstrated EO imaging through weather and obscurants. Designed and demonstrated targeting concepts based on high precision pointing, range gating, and image processing. Evaluated non-mechanical EO beam steering devices. Investigated component designs for ladar apertures.

(U) $1,808 Developed countermeasure technologies for use against IR- and EO-guided missiles. Continued to design components and refine techniques to defeat imaging missile seekers. Continued exploiting advanced infrared missile technology.

(U) $1,539 Developed aerospace missile and laser warning technologies to accurately cue countermeasures. Laboratory tested temporal and spectral tracking algorithms focused on multi-spectral imaging techniques. Evaluated advanced laser warning sensor component hardware for application

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(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

in a space environment.

(U) $1,781 Investigated the feasibility of designing and fabricating a three-dimensional (3-D) Adverse Weather Ballistic Imaging and Targeting System imaging laser radar sensor for unmannned aerial vehicles. This laser radar would be capable of making one-foot resolution 3-D images of targets and areas of interest through moderate cloud cover.

(U) $13,602 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $4,253 Develop technology for non-cooperative identification of airborne and ground-based platforms. Conduct air-to-air and air-to-ground demonstrations of long-range combat identification (CID) sensors. Test range-resolved coherent image processing and extraction algorithms, including 3-D block registration algorithms. Conduct long-range experiments using advanced 3-D sensors for CID applications. Continue passive hyperspectral model development, validation, and performance predictions, and assess signature-based data processing performance based on ground demonstration data. Continue flights, analysis, and evaluation of multi-function ladar for identification of ground targets.

(U) $3,149 Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification. Develop pulsed vibration sensing system for long-range CID. Begin developing flight-capable, multi-function architectures. Integrate platform compensation techniques into new architectures. Develop breadboard multi-spectral transmitter, and predict performance for different types of targets.

(U) $4,029 Develop innovative techniques and components to target difficult objects in degraded atmospheric conditions. Continue utility analysis of high altitude active sensors, including platform trades. Perform tower tests of an active multi-spectral imaging system. Demonstrate imaging through weather and obscurants through flight test of active imaging sensors. Design and demonstrate concepts based on high precision pointing, range gating, and image processing. Develop concepts for airborne application of non-mechanical beam steering devices, including mitigating aero-optical effects. Investigate concepts for combined radio frequency and electro-optical (EO) apertures.

(U) $1,948 Develop countermeasure technologies for use against infrared (IR) guided missiles and EO threats. Continue to design components and refine techniques to defeat imaging missile seekers. Continue the exploitation of advanced IR missile technology.

(U) $649 Develop aerospace missile and laser warning technologies to accurately cue countermeasures. Laboratory test temporal and spectral tracking algorithms focused on multi-spectral imaging techniques. Initiate the testing of an advanced laser warning receiver for application in a space environment.

(U) $14,028 Total

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$4,004	Develop technology for non-cooperative identification of airborne and ground-based platforms. Conduct ground- and air-based testing and demonstration of an advanced Combat Identification (CID) system with multi-spectral detection and cueing, and active electro-optical (EO) target long-range combat identification sensors. Integrate advanced, three-dimensional (3-D) focal planes and algorithms in a concept design of a high altitude system to detect targets in relevant environments. Continue passive hyper-spectral model development, validation, and performance predictions specifically supporting the flying testbed. Define technologies suited to layered sensing approaches for deep penetration and continuous target area coverage.
(U)	$2,010	Develop optical transmitter technology capable of sensing multiple target characteristics for robust non-cooperative target identification. Demonstrate multi-function, pulsed vibration imaging sensing system for long-range CID. Test and evaluate sensors utilizing 3-D focal planes. Continue development of flight capable multi-function architectures. Continue fabricating a breadboard multi-spectral transmitter and evaluate performance for different types of targets.
(U)	$7,510	Develop innovative techniques and components to target objects in degraded atmospheric conditions. Develop high altitude active sensor performance specifications and concept design. Integrate weather and obscurant penetration concepts. Evaluate non-mechanical beam steering concepts for high altitude sensor applications including precision pointing, focusing, and wavefront correction. Perform an initial demonstration of a combined EO and radio frequency aperture. Perform tests, analyses, and evaluations of a specialized multi-function ladar for the detection and characterization of difficult targets.
(U)	$1,149	Develop countermeasure technologies for use against infrared (IR) guided missiles and EO threats. Complete an IR scene projector to assess imaging sensor capabilities. Begin evaluating onboard and offboard techniques to defeat imaging missile seekers. Continue exploiting advanced IR missiles and IR sensor technologies.
(U)	$997	Develop aerospace missile and laser warning technologies to accurately cue countermeasures. Laboratory test temporal and spectral tracking algorithms focused on multi-color imaging techniques. Initiate developing an advanced laser warning receiver for space and airborne applications.
(U)	$15,670	Total

(U) B. Project Change Summary

Not Applicable.

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	PROJECT 2003

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602500F, Multi-disciplinary Space Technology.

(U) PE 0603253F, Advanced Sensor Integration.

(U) PE 0602301E, Intelligence System Program.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT: 4916

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
4916 Electromagnetic Tech	8,807	7,940	9,255	9,737	10,075	10,475	10,898	11,334	Continuing	TBD

Note: In FY 2002, this work transferred to this project from PE 0602702F, Project 4600.

(U) A. Mission Description

This project develops technology for sensor systems that cover the electromagnetic spectrum--from radio frequency (RF) to optical. It develops RF antennas and associated electronics for airborne and space-based surveillance. It also investigates RF scattering phenomenology for applications in ground and air moving target indicators in extremely cluttered environments. The project develops active and passive electro-optical (EO) sensors for use in concert with RF sensors. It develops low-cost active sensors that use reliable high-performance solid state components for target detection and identification and missile threat warning. The project also develops passive multi-dimensional sensors to improve battlefield awareness and identify threats at long-range.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,173	Developed experimental and theoretical techniques for the characterization of electromagnetic scattering from targets and terrain as applied to the detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms.
(U)	$2,307	Designed and developed antennas for airborne and space-based surveillance. Designed, analyzed, and built advanced large, lightweight antenna arrays. Developed new algorithms for digital beam-formed multi-beam antennas. Developed high-speed electronics for antenna front ends.
(U)	$2,053	Designed and developed next generation EO techniques and advanced components for use in detection and identification of concealed targets. Designed and fabricated multi-function sensor arrays and innovative materials and device technologies for optical beamsteering. Designed and developed active components and advanced integration techniques for autonomous ladar-guided munitions and other imaging applications. Developed optical processing techniques for optical aberration in aircraft-generated turbulence.
(U)	$2,274	Developed hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates. Established the viability of tomographic hyperspectral sensing techniques for missions that have not been able to capitalize on the power of spectral target identification tools. Evaluated the applicability of these and new tomographic hyperspectral sensor concepts to the characterization of explosions and missile launches, and to the development of techniques for real-time bomb damage assessment.
(U)	$8,807	Total

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,832	Investigate detecting difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms. Develop models and experimental techniques for characterizing radio frequency (RF) scatter from targets, ground clutter, and foliage.
(U)	$1,749	Design and develop antennas for airborne and space-based surveillance. Design, analyze, and build advanced large, lightweight antenna arrays. Develop new algorithms for digital beam forming and limited-scan phased array antennas. Develop high-speed electronics for antenna front end applications and micro-electro-mechanical systems technology for delayed line switching in phased arrays.
(U)	$1,580	Design and develop new electro-optical (EO) techniques and components for detecting and identifying concealed targets. Design and fabricate multi-function sensor arrays and the associated materials and device technologies for optical beam steering. Design and develop active components and integration techniques for autonomous three-dimensional ladar-guided munitions and other imaging applications. Develop optical processing techniques that compensate for optical aberration in aircraft-generated turbulence.
(U)	$1,800	Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates. Establish viability of tomographic hyperspectral sensing techniques for aerospace applications. Demonstrate the applicability of tomographic hyperspectral sensor concepts to characterizing explosions and missile launches, and to developing techniques for real-time bomb-damage assessment.
(U)	$979	Continue developing a phased array antenna control system by implementing computer algorithms that control the antenna's beam pointing, and by developing the computer hardware necessary to enable system operators to monitor the health and status of the antenna and monitor antenna operations.
(U)	$7,940	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,269	Investigate the detection of difficult airborne and ground-based targets in clutter from surveillance platforms. Develop models and experimental techniques for the characterization of RF frequency scattering from targets, ground clutter, and foliage.
(U)	$2,429	Design and develop antennas for aerospace surveillance. Design, analyze, and build advanced large, lightweight antenna arrays. Develop new algorithms for digital beam forming and limited-scan phased array antennas. Develop high-speed electronics antenna front end applications and micro-electro-mechanical systems technology for delayed line switching in phased arrays.
(U)	$2,179	Design and develop new EO techniques and components for detecting and identifying concealed targets. Design and fabricate multi-function sensor arrays and the associated materials and device technologies for optical beam steering. Design and develop active components and

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

integration techniques for autonomous three-dimensional ladar-guided munitions and other imaging applications. Develop optical processing techniques that compensate for optical aberrations in aircraft-generated turbulence.

(U) $2,378 Develop hardware and software for passive multi-dimensional sensing in the thermal infrared spectral wavelength range at high frame rates. Establish viability of tomographic hyperspectral sensing techniques for aerospace applications. Demonstrate the applicability of tomographic hyperspectral sensor concepts to characterizing explosions and missile launches, and to developing techniques for real-time bomb-damage assessment.

(U) $9,255 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602500F, Multi-disciplinary Space Technology.

(U) PE 0602702F, Command Control and Communications.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT: 5016

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5016 Photonic Component Technology	0	2,242	2,914	3,334	2,405	2,436	2,506	2,576	Continuing	TBD

Note: In FY 2003, photonic component technology work previously performed in this PE, Project 2002, transferred to this project.

(U) A. Mission Description

This project focuses on designing and developing methods to generate, control, receive, transmit, and process opto-electronic (mixed) signals for radio frequency (RF) sensor aerospace applications. Enabling technologies developed under this project for intelligence, surveillance, reconnaissance, electronic warfare (EW), and precision engagement sensors include: low noise, aerospace environmentally-qualified signal control components (e.g., electro-optical (EO) switches, micro-opto-electronic mixed signals; electro-optical components for RF links; photonic signal control, distribution, and signal processing; multi-function, aerospace-qualified, opto-electronic integrated circuits; wide band photonic-based high-speed EO analog-to-digital and digital-to-analog converters; and opto-electronic intraconnects and interconnects. This project designs, develops, fabricates, and evaluates techniques for integrating various combinations of photonic and electronic technologies. The main purpose is to demonstrate significantly improved military sensors of smaller size, lower weight, lower cost, lower prime power, higher reliability, and improved performance -- as compared to current systems. The device, component, and subsystem technology developments under this project are military unique and based on Air Force and other Department of Defense weapon systems requirements in the areas of radar, sensors, communications, EW, navigation, and smart weapons.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$0	No Activity
(U)	$0	Total

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,575	Develop high performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband RF phased array antenna beamforming and control, and for high data rate aerospace sensors and communication systems.
(U)	$667	Develop ultrafast, wideband photonic analog-to-digital mixed signal conversion component technology.
(U)	$2,242	Total

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$2,248	Continue developing high performance integrated photonic technology link, interconnect, and switching components and subsystems for wideband radio frequency phased array antenna beamforming and control, and for high data rate aerospace sensors and communication systems.
(U)	$666	Continue developing ultrafast, wideband photonic analog-to-digital mixed signal conversion component technology.
(U)	$2,914	Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602500F, Multi-disciplinary Space Technology.
(U) PE 0603203F, Advanced Aerospace Sensors.
(U) PE 0603270F, Electronic Combat Technology.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT: 5017

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
5017	RF Processing for ISR Sensors	0	9,078	6,700	7,911	7,886	7,482	7,674	7,867	Continuing	TBD

Note: In FY 2003, efforts in radio frequency (RF) processing for intelligence, surveillance, and reconnaissance (ISR) sensors previously performed in this PE, Project 7622, transferred to this project.

(U) A. Mission Description

This project develops and assesses radar technology for affordable, reliable, all weather aerospace ISR systems. Emphasis is on detecting and tracking surface and airborne targets that have difficult to detect signatures due to reduced cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. Techniques exploited include the use of multiple RF phenomenologies, multi-dimensional adaptive processing, advanced waveforms, and knowledge-aided processing techniques.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $0 No Activity

(U) $0 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $1,460 Investigate techniques for implementing distributed airborne sensor systems to increase sensitivity and improve location accuracy. These techniques include sparse arrays with maneuvering platforms and improved location accuracy using interfermetric methods combined with knowledge-based responsive mode selections.

(U) $1,987 Investigate techniques for multi-intelligence data acquisition from a single platform. Investigate common waveform techniques, knowledge-based scheduling, and advanced target detection for both unconcealed and concealed targets. Determine the electromagnetic compatibility issues associated with simultaneously hosting and operating multiple radars, electronic support measure receivers, integrated communications, and electronic attack components on a single platform. Investigate methods to mitigate unintentional interference sources to multi-intelligence platforms from the ground and in the air, such as commercial broadcast assets, civilian radar assets, and commercial communications systems.

(U) $3,828 Develop multi-mission aerospace microwave processing algorithms to detect and locate advanced cruise missiles, slowly moving ground targets, and stationary targets in severe clutter and jamming environments. Study multi-mission adaptive radar algorithms to support various operational modes, including air and ground target detection, ground target imaging, electronic protection, and passive RF emission detection. Study

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

advanced waveforms for achieving transmitter adaptivity and simultaneous multi-mode operation to improve interference rejection, self-protection, and target identification by exploiting diversities in frequencies, delays, polarizations, modulations, and codings. Develop knowledge-aided radar signal processing techniques for improved detection and false alarm control performance in ground moving target indication sensors.

(U) $530 Study and analyze technology for detecting and precisely locating concealed targets using standoff aerospace platforms. Initiate an investigation of emerging adaptive processing techniques for knowledge-aided multi-mission processing and resource management. Initiate the study of adaptive processing techniques for multi-mission conformal arrays. Initiate the study of wideband and polarization adaptive processing techniques for multi-function radar.

(U) $1,273 Test and evaluate Global Positioning System receivers to assess potential problems from spectrum encroachment by ultra-wideband devices.

(U) $9,078 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $498 Demonstrate, through computer simulation and emulation, the techniques for the implementation of distributed airborne sensing techniques for detecting, locating, and engaging airborne and ground targets.

(U) $2,312 Continue to investigate techniques for multi-intelligence data acquisition from a single platform. Validate multi-function radar sensing through computer simulations and emulations. Continue investigating the electromagnetic compatibility issues associated with hosting multiple radars, electronic support measure receivers, integrated communications equipment, and electronic attack components on a single platform capable of operating simultaneously. Continue investigating methods to mitigate unintentional interferers on the ground and in the air such as commercial broadcast assets, civilian radar assets, and commercial communications systems on multi-intelligence platforms. Initiate investigating electronic counter-countermeasure techniques that will enable maintaining a surveillance capability in various advanced jamming scenarios based upon multi-intelligence single platform sensing.

(U) $3,109 Evaluate and refine multi-mission aerospace microwave processing algorithms for detecting and locating advanced cruise missiles, slowly moving ground targets, and stationary targets in severe clutter and jamming environments. Develop multi-mission adaptive radar algorithms to support various operational modes including air and ground target detection, ground target imaging, and electronic protection. Develop advanced waveforms for achieving transmit adaptivity and simultaneous multi-mode operations to improve interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization and modulation, and coding. Evaluate and refine knowledge-aided radar signal processing techniques for improved detection and false alarm control performance in ground moving target

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

indication sensors.

(U) $781 Develop emerging adaptive processing techniques for knowledge-aided multi-mission processing and resource management. Study and analyze adaptive processing techniques for multi-mission conformal arrays. Study and analyze wideband and polarization adaptive processing techniques for multi-function radar. Initiate investigating distributed processing technology for next generation, deep-reach target detection and tracking.

(U) $6,700 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602500F, Multi-disciplinary Space Technology.

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) PE 0603270F, Electronic Combat Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 02 - Applied Research

PE NUMBER AND TITLE: 0602204F Aerospace Sensors

PROJECT: 6095

COST ($ in Thousands)	FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
6095 Sensor Fusion Technology	12,568	12,407	12,235	14,071	15,948	16,590	16,961	17,328	Continuing	TBD

Note: In FY 2003, space unique tasks in this project transferred to PE 0602500F, Project 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project develops the technologies required to perform management and fusion of sensor information for timely, comprehensive situational awareness, automatic target recognition (ATR), integrated fire control, and bomb damage assessment. This project determines the feasibility of technologies and concepts for fire control that help to precisely locate, identify, and target airborne and surface targets. The project emphasizes finding reduced signature targets and targets of opportunity. It will enable new covert tactics for successful air-to-air and air-to-surface strikes.

(U) FY 2002 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$1,838	Developed and evaluated single and multi-sensor ATR lethality algorithms to dramatically improve capability to rapidly find, track, and target time-critical mobile targets. Performed laboratory demonstrations of adaptive resource allocation methods for ATR. On embedded high-performance computing systems, developed real-time ATR algorithms for time-critical targets. Developed and evaluated algorithms and concepts for detecting and targeting targets under trees.
(U)	$2,431	Developed and evaluated single and multi-sensor radar target signature models to support ATR in strike operations. Developed target signature models for multi-sensor fusion of synthetic aperture radar, electro-optical multispectral systems, and signals intelligence in reconnaissance ground stations. Sensor fusion will provide the ability to maintain tracks of vehicle groupings through multiple platforms and missions with a high probability of detection and a less than 1% false alarm rate.
(U)	$1,673	Developed precision time, position, and velocity sensors capable of operating in jamming environments enabling multiple platform sensor-to-shooter operations. Continued developing Global Positioning System specific jamming mitigation techniques for operations in hostile radio frequency environments.
(U)	$4,833	Developed and demonstrated enabling ATR technologies for intelligence, surveillance, and reconnaissance applications. Continued evaluating physics-based and adaptive learning techniques.
(U)	$1,793	Developed ATR and sensor fusion performance assessment technology. Conducted ATR performance evaluation theory research.
(U)	$12,568	Total

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,789	Continue integrating, evaluating, and demonstrating single and multi-sensor automatic target recognition (ATR) and sensor fusion algorithms for rapidly finding, tracking, and targeting mobile targets. Continue integrating real-time ATR algorithms, for time-critical targets, on embedded high-performance computing systems. Complete laboratory demonstration of adaptive resource allocation methods. Continue integrating and evaluating algorithms and concepts for detecting and targeting targets under trees. Complete developing single sensor ATR performance assessment technology, and multi-sensor and sensor fusion assessment technology. Continue ATR performance evaluation theory research. Complete the first single sensor ATR performance prediction model.
(U)	$3,666	Develop, evaluate, and demonstrate target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Develop target signature models for signature exploitation of synthetic aperture radar, electro-optical multi-spectral systems, and signals intelligence sensors. Demonstrate the ability to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop modeling and simulation tools that can estimate warfighter effectiveness enhancements due to inserting ATR and sensor fusion aids into the reconnaissance and strike components of the time-critical targeting kill chain.
(U)	$4,321	Develop and demonstrate enabling ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in intelligence, surveillance, and reconnaissance (ISR) and combat identification (CID) applications. Complete the evaluation of adaptive learning techniques for target identification. Initiate laboratory demonstration of adaptive sensor management algorithms for target detection, tracking, and identification. Continue evaluating physics-based techniques for target detection and identification for ISR and CID applications.
(U)	$631	Develop precision time, position, and velocity sensors capable of operating in jamming environments. These sensors will enable multiple platform sensor-to-shooter operations. Continue developing Global Positioning System-specific jamming mitigation techniques for operation in hostile radio frequency environments, with an emphasis on synergistically integrating anti-jam technologies. Develop virtual flight test technology for improved assessment of reference sensors.
(U)	$12,407	Total

(U) FY 2004 ($ in Thousands)

(U)	$0	Accomplishments/Planned Program
(U)	$3,709	Continue evaluating and integrating multi-sensor ATR and sensor fusion algorithms to provide a dramatic improvement in capability to rapidly find, track, and target mobile targets. Improve image formation development and processing of Synthetic Aperture Radar data from Research and Development (R&D) data collections. Automate image analysis and truthing tools. Improve the ATR R&D computer and networking

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(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

infrastructure via software, hardware, and network integration enhancements. Assess the effectiveness of real-time automatic target recognition (ATR) algorithms for time-critical targets on embedded high-performance computing systems. Develop challenge problem sets to standardize ATR evaluation across the ATR community. Continue integrating and evaluating algorithms and concepts for detecting and engaging targets under trees. Begin integrating detection and identification algorithms for targets under trees into high-performance computing systems. Complete developing multi-sensor and sensor fusion assessment technologies. Continue ATR performance evaluation theory research. Continue developing the first multi-sensor ATR performance prediction model.

(U) $3,891 Continue developing, evaluating, and demonstrating target signature models to support ATR and sensor fusion algorithm development and testing for reconnaissance and strike mission applications. Continue maturing target signature models for signature exploitation of radio frequency sensors, electro-optical multispectral systems, and signals intelligence sensors. Continue generating synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Develop synthetic scene data generation capability to augment and enhance existing Research and Development and operational data sets. Continue developing modeling and simulation tools for estimating warfighter effectiveness enhancements enabled by inserting ATR and sensor fusion aids to the reconnaissance and strike components of the time-critical targeting kill chain.

(U) $4,635 Develop and demonstrate enabling ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in intelligence, surveillance, and reconnaissance (ISR) and combat identification (CID) applications. Continue exploiting adaptive learning techniques for target identification using three-dimensional sensors. Continue studying exploitable radar features for target detection, tracking, and identification. Continue evaluating physics-based techniques for target detection and identification for ISR and CID applications. Initiate laboratory demonstration of advanced algorithms for detection and identification of targets under trees in the presence of heavy camouflage, concealment, and deception.

(U) $12,235 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602500F, Multi-disciplinary Space Technology.

(U) PE 0603203F, Advanced Aerospace Sensors.

(U) PE 0602602F, Conventional Munitions.

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(U) C. Other Program Funding Summary ($ in Thousands)

(U) PE 0603270F, Electronic Combat Technology.

(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.

(U) PE 0603762E, Sensor and Guidance Technology.

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

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE: February 2003
BUDGET ACTIVITY: 02 - Applied Research	PE NUMBER AND TITLE: 0602204F Aerospace Sensors / PROJECT: 7622

COST ($ in Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	Cost to Complete	Total Cost
7622	RF Sensors & Countermeasures Tech	24,737	16,456	16,929	20,538	27,587	29,077	26,712	27,299	Continuing	TBD

Note: In FY 2003, efforts in radio frequency (RF) processing for intelligence, surveillance, and reconnaissance (ISR) sensors transferred from this project to this PE, Project 5017. Also in FY 2003, space unique tasks in this project transferred to PE 0602500F, Project 5029, in conjunction with the Space Commission recommendation to consolidate all space unique activities.

(U) A. Mission Description

This project develops and assesses RF sensing concepts for aerospace applications through modeling and simulation. This project also develops and evaluates technology for fire control radar, electronic combat (EC), and integrated radar and EC systems. It emphasizes the detecting and tracking of surface and airborne targets with RF signatures that are difficult to detect due to reduced radar cross sections, concealment and camouflage measures, severe clutter, or heavy jamming. This project also develops the RF warning and countermeasure technology for advanced EC applications. Specifically, it develops techniques and technologies to detect and counter the links and sensors of threat air defense systems and hostile command and control networks. The project also exploits emerging technologies and components to provide increased capability for offensive and defensive RF sensors, including radar warning, RF EC, and electronic intelligence applications.

(U) FY 2002 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $2,131 Developed aerospace microwave sensor technologies for detecting, locating, and engaging airborne and ground targets. Conducted airborne radar target and clutter phenomenology data collections used to evaluate, validate, and improve engineering tools supporting ISR and multi-intelligence sensor concept studies and system analyses. Demonstrated sensor performance through in-flight experiments and simulations.

(U) $3,483 Developed aerospace microwave processing algorithms for detecting and locating advanced cruise missiles and slow airborne targets, as well as stationary and moving ground targets in severe clutter and jamming environments. Developed multi-mission adaptive radar algorithms to support various operational modes including air and ground target detection, ground target imaging, electronic protection, and passive RF emission detection. Developed advanced waveforms to achieve transmit adaptivity and simultaneous multi-mode operation. Improved interference rejection, self-protection, and target identification by exploiting diversity in frequency, delay, polarization, modulation, and coding.

(U) $1,208 Developed technology for detecting and precisely locating concealed targets using standoff aerospace platforms. Developed and evaluated technology for airborne ground-penetrating radar. Developed and evaluated signal processing algorithms for improving detection and false alarm performance in foliage-penetrating radar.

(U) $1,671 Developed affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by degrading enemy radar, missile, and command and control systems. Developed multi-function electronic warfare technique waveforms. Evaluated exploitations of advanced radio

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	PROJECT 7622

(U) A. Mission Description Continued

(U) FY 2002 ($ in Thousands) Continued

frequency (RF) threats. Developed optimized electronic warfare (EW) techniques to degrade modern radar, communications, and missile threat systems.

(U) $2,730 Developed technology to enable low-cost upgrades to RF signal receivers. Modeled threat identification algorithms for next-generation threat warning receivers. Evaluated state-of-the-art digital receiver subsystems. Designed advanced very-high frequency receiver improvements for detecting targets under trees. Designed novel RF photonic analog-to-digital converter circuitry for order-of-magnitude gains in performance accuracy versus current state-of-the-art.

(U) $3,638 Developed affordable antenna technology for use in operational and future aerospace platform electronic receivers and apertures. Evaluated wideband, high precision, interferometric, multi-mode, direction-finding antennas in the laboratory. Developed design tools to predict antenna performance installed on host platform models. Developed robust ultra-wideband front end electronics to handle large signals.

(U) $2,723 Developed and validated, via a global infosphere experiment, the radar architectures, aperture technology, and signal processing to support a space-based moving target indication sensor. Used the collaborative engineering environment to model and assess RF architectures and signal processing techniques. Analyzed the utility of a space-based sensor architecture.

(U) $1,915 Designed and validated multi-intelligence sensor technologies for total battlefield awareness. Evaluated single platform technologies for common waveform utilization, knowledge-based function scheduling, and superior difficult target detection for both in-the-clear and concealed targets. Developed and evaluated hybrid sensor systems, including space/air/ground combinations delivering improved location accuracies and tracking strategies.

(U) $5,238 Developed and analyzed concepts for a multi-mission unmanned aerial vehicle based sensor suite capable of detecting and tracking advanced aerial targets and both exposed and concealed ground targets. Determined enabling technologies required for full target surveillance capability.

(U) $24,737 Total

(U) FY 2003 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $6,696 Develop affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by degrading enemy radar, missile, and command and control systems. Develop multi-function EW technique waveforms. Continue exploitation evaluations against new, advanced RF threats. Develop optimized EW techniques to degrade modern radar, communications, and missile threat systems. Initiated phase calibration development.

(U) $5,098 Develop technology to enable affordable upgrades to RF signal receivers. Model threat identification algorithms for next generation threat warning receivers. Evaluate state-of-the-art radar and EW digital receiver subsystems with Gallium Arsenide and Indium Phosphide radio

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(U) A. Mission Description Continued

(U) FY 2003 ($ in Thousands) Continued

frequency (RF) components (analog-to-digital converters, filters, mixers, etc.) for laboratory environment scenario testing. Design advanced very high frequency (VHF) receiver improvements for detecting targets under trees.

(U) $3,783 Develop robust, ultra wide bandwidth antenna technology for use in operational and future aerospace platform electronic apertures. Demonstrate prototype wideband, high precision interferometric multi-mode direction finding antennas. Develop design tools to predict antenna performance installed on host platform models. Demonstrate components and techniques that increase five-fold the signal handling capability of an aperture.

(U) $879 Develop and evaluate innovative multi-function RF sensing concepts for aerospace applications through modeling and simulation with an emphasis on system engineering.

(U) $16,456 Total

(U) FY 2004 ($ in Thousands)

(U) $0 Accomplishments/Planned Program

(U) $5,036 Continue developing affordable RF jamming technology and concepts that enhance aerospace vehicle survivability by degrading enemy radar, missile, and command and control systems. Continue developing multi-function electronic warfare (EW) technique waveforms. Continue exploitation evaluations against new, advanced RF threats. Continue to develop optimized EW techniques to degrade modern radar, communications, and missile threat systems. Perform laboratory demonstration of phase calibration system for a monopulse countermeasure technique to protect all Air Force platforms.

(U) $2,064 Continue developing technology to enable affordable upgrades to RF signal receivers. Continue modeling threat identification algorithms for next generation threat warning receivers. Continue designing advanced VHF receiver improvements for detecting targets under trees. Evaluate the integrated tool suite in the modeling, simulation, design, and characterization environment for mixed-signal (digital, RF, microwave, etc.) component development in advanced and emerging technologies. Demonstrate breadboard electronic/photonic wideband digital receiver for multi-mode/multi-function applications.

(U) $918 Continue developing robust, ultra-wide bandwidth antenna technology for use in operational and future aerospace platform electronic apertures. Continue demonstrating breadboard wideband, high precision interferometric multi-mode direction finding antennas. Continue developing design tools to predict antenna performance installed on host platform models. Develop techniques that provide low-cost, lightweight phased arrays for low band applications.

(U) $6,704 Continue developing and evaluating innovative multi-function RF sensing concepts for air and space applications through modeling and simulation with an emphasis on system engineering. Develop and evaluate advanced multi-function and multi-intelligence RF sensors for intelligence, surveillance, and reconnaissance and targeting of time-critical targets. Develop testbed integration techniques for advanced

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	PROJECT: 7622

(U) A. Mission Description Continued

(U) FY 2004 ($ in Thousands) Continued

multi-intelligence sensor hardware and algorithms. Develop and evaluate multi-platform sensor coordination and synchronization techniques.

(U) $2,207 Develop digital radio frequency receiver/exciter technology to support digital beamforming (DBF). Analyze and develop approaches to address DBF specific issues such as such as coherence of multiple channels, digital true time delay, channel equalization, distributed waveform generation, and array calibration. Develop techniques for integrating multi-intelligence radio frequency receiver/exciter subsystems into aperture and signal processing testbeds.

(U) $16,929 Total

(U) B. Project Change Summary

None.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602500F, Multi-disciplinary Space Technology.
(U) PE 0603203F, Advanced Aerospace Sensors.
(U) PE 0603253F, Advanced Avionics Integration.
(U) PE 0602782A, Command, Control, Communications Technology.
(U) PE 0602232N, Navy C3 Technology.
(U) PE 0603792N, Advanced Technology Transition.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.