Space Surveillance Radar

Mission: Provide Space Surveillance Data to Support the Space Control Mission

Goal of the Test	Quantitative Mission-Oriented Response Variables		Test Design		Scope		
	Effectiveness / Suitability	Thresholds	Factors (Levels)	Scientific Test and Analysis Techniques with Operational Context	Effort (24/7 ops)	Resources	Test Period
Evaluate Autonomous Surveillance	Uncued Observation Metric Accuracy	* Time < 1 s * Elevation, Azimuth <1.0 degree * Range <100 m * Range Rate < 200 m/s	Altitude (600 - 7k km) Inclination (8◦ - 172◦) Size (10 - 50 cm)	A. 1 Sample Variance Test with LASER-ranged targets * 95% power, 5% significance (α), 10% effect size B. 4x2x3 full factorial Analysis of Variance (ANOVA) design using live (satellite catalog (SATCAT)) and simulated tracks (Table D-1) * 95% power, 5% α, 10% effect size * Lowest power to differentiate between levels of a factor & their 1st order interactions is 96.1%, at 5% α and 0.5 S/N	5 days 25 days	Space Surveillance Network (SSN) radar and optical sensors NASA laser ranging AFSPC/A9 analysts M&S	DT_2 IOT&E
	Minimum Detectible Target (MDT) Size (KPP)	Objects * 10 cm: 600 ≤ x ≤ 4000 km * 50 cm: 4000 < x ≤ 7000 km	Inclination (8◦ - 172◦)	Logistic Regression Model with a 1x3 full factorial design using live 10cm SATCAT tracks (Table D-5). M&S needed for 50 cm tracks * Power to determine factor effects is 90% at 5% α, 10% effect size.	25 days		DT_2
	Uncued Probability of Track (KPP)	50% of objects be tracked if they pass through the radar's field of view (FOV)	Altitude (600 - 7k km) Inclination (8◦ - 172◦)	Logistic Regression Model w/ 3x3 full factorial design using live SATCAT tracks (Table D-2). * Lowest power to differentiate between levels of a factor is 90%, at 5% α, 10% effect size. 75% power for detecting the 1st order factor interaction	8 days		DT_2
	Track Coverage (KPP)	* 1 track/day in the altitude range 600-4000 km * 2 tracks/day in the altitude range 4000-7000 km	Inclination (8◦ - 172◦) Size (10 - 50 cm)	Logistic Regression Model w/ 3x2 full factorial design using live SATCAT and simulated tracks (Table D-3). * Lowest power to differentiate between levels of a factor & factor interactions is 90%, at 5% α, 10% effect size	23 days		DT_2
	Object Correlation	97% of previously detected objects must be correlated w/ SATCAT	Altitude (600 - 7k km) Inclination (8◦ - 172◦)	Logistic Regression Model with a 3x3 full factorial design using live SATCAT tracks (Table D-4) * Lowest power to differentiate between levels of a factor & factor interactions is 90%, at 5% α, 10% effect size	8 days		IOT&E
Evaluate Cued Operations	Cued Observation Metric Accuracy	* Time < 1s * Range, elevation, azimuth as specified in Figure 3-5. * Range Rate < 20 m/s	Altitude (600 - 7k km) Inclination (8◦ - 172◦) Size (10 - 50 cm)	A. Test of 1 Proportion with LASER-ranged targets * 95% power, 5% α, 10% effect size B. Logistic Regression Model with a 4x2x3 full factorial design using live SATCAT and simulated tracks (Table D-1) * Lowest power to differentiate between levels of a factor & factor interactions is 90%, at 5% α, 10% effect size	9 days 25 days	Resources listed above plus JSPOC	DT_2 IOT&E
	Probability of Track (KPP)	90% of objects be tracked if they pass through the radar's FOV	Altitude (600 - 7k km) Inclination (8◦ - 172◦)	Logistic Regression Model w/ 3x3 full factorial design using live SATCAT tracks (Table D-2). * Lowest power to differentiate between levels of a factor is 95%, at 5% α, 10% effect size. 85% power for detecting the factor interaction	8 days		DT_2

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	Effectiveness / Suitability	Thresholds	Factors (Levels)	Scientific Test and Analysis Techniques with Operational Context	Effort (24/7 ops)	Resources	Test Period
Evaluate Uncorrelated Target Processing	Initial Orbit Determination Accuracy	Reacquisition and correlation > 75% of objects w/in 24 hrs	Altitude (600 - 7k km)	Logistic Regression Model with a 1x3 full factorial design using live SATCAT tracks (Table D-8). * Power to determine factors effects is 90% at 5% α and 10% effect size.	20 days	SSN sensors JSPOC AFSPC/A9 analysts	IOT&E
Evaluate Narrow-band Space Object Identification	Radar Cross Section (RCS) Accuracy	RCS > (classified) dBsm	Size (10 - 50 cm)	One-way ANOVA with 1x3 factorial design using calibration spheres (Table D-10) * Power to determine factors effects is 90% at 5% α and 10% effect size.	21 days	JSPOC NASIC SSN sensors	DT_2
Evaluate space event detection and processing	Data Timeliness	data latency to end user must be < 2 min 99% of the time		Tolerance Intervals using the SATCAT (Table D-9) * 90% power, 5% α, 10 effect size	1 day	JSPOC M&S SSN sensors	IOT&E
	Flexible Coverage	* 0.5 cm: 600 ≤ x ≤ 1000 km * 5 cm: 1000 < x ≤ 2000 km * 8 cm: 2000 < x ≤ 4000 km * 15 cm: 4000 < x ≤ 12K km	Inclination (8◦ - 172◦)	A. Logistic Regression Model w/ 1x3 full factorial design using live SATCAT and simulated tracks (Table D-6). B. Logistic Regression Model with a 1x3 full factorial design using NaK debris (Table D-7). M&S needed for inclinations < 30 degrees	20 days 13 days		IOT&E IOT&E
	SOC Functionality	tasking and tracking 300 objects	# of objects (1 -400)	M&S of space events, such as ASATs, On-Orbit Maneuvers, New Launches, and Space Object Breakups.	10 days		IOT&E
Evaluate cybersecurity defenses	prevent, detect, react, and restore	See Cybersecurity section for detailed measures and thresholds		A. Cooperative Vulnerability and Penetration Assessment (CVPA) with the system in it's operational configuration. B. Fix C. Adversarial Assessment (AA) of the system in it's operational configuration against a nation-state cyber-threat	15 days 30 days 15 days	CVPA Team AA Team	DT_2 IOT&E
Evaluate DODIN interoperability	Net- Ready (KPP)	TBD		JITC certification	14-28 days	JTIC	DT
Evaluate Suitability	E3: On-Orbit E-Field	≤ 23 v/m, peak, RMS ≤ 8 v/m, avg, RMS	Range (100 -1k km)	Construct an RF profile based off the contractor design: RF antenna gain versus angle off-boresight. Refine based on: 1. Transmitter subassembly anechoic chamber testing 2. CONUS prototype testing - Near field: place RF detectors a precise distance from radar to determine the transmitted power to a known point - Ground: RF survey of the surrounding area 3. Fielded operational system - Repeat near field and ground RF survey tests - Perform atmospheric measurements with aircraft - Leverage in-band on-orbit assets to measure RF		land, air, and on-orbit E/M receivers	DT
	E3: Atmospheric Power Density	≤ 43.8 dBW/m2, peak, RMS ≤ 15.8 dBW/m2, avg, RMS	Range (10 m - 20 km)				
	E3: Ordnance	≤ 2,500 v/m, peak, RMS ≤ 220 v/m, average, RMS	Range (0- 5 km)				
	E3: Personnel	≤ 10 W/m2, averaged over 30 minutes	Range (0- 5 km)				
	Operational Availability	System Ao ≥ 95% SOC Ao Ao ≥ 98% System MTBCF ≥ 1000 hrs SOC MTBCF ≥ 1000 hrs		AMSAA-PM2 method for growth tracking and projection. (See Reliability Growth section.)	140 days	diesel fuel	DT & OT