Quantifying Space in Joint Military Operations

This Briefing is UNCLASSIFIED

Modeling, Simulation, and Analysis (MS&A)
Space User’s Group (SPUG)

11-12 June 2002

MAJ Bill McLagan
USSPACECOM
Analysis Directorate
Comm: (719) 554-5122
DSN: 692-5122
Fax: x4070
Email: bill.mclagan@peterson.af.mil
Class: mclaganb@spacecom.smil.mil
The Problem

Limited space (and CNO) representation in modeling and simulation for analysis ... also affects training & acquisition

Limited funding to address the problem through analysis, wargamming, and infusing space in training exercises

Limited findings to quantify the added value of space systems (and CNO) for the warfighter

Need to start with requirements:
- Model deficiencies (i.e. suite of space and CNO models)
- Space functionality requirements (e.g. data, algorithms, measures of effectiveness / performance, etc.)
- Funding requirements
Defense Science Board Task Force Report titled “Space Superiority” dated Sep 99:

- “...nation currently lacks the necessary modeling and simulation capabilities required to fully and appropriately assess the “military utility and worth” of national security space systems.
- “...deficiency undermines our ability to correctly balance the funding priorities between space systems, weapons systems and other support junctions to maximize US military force combat effectiveness.


- “There was difficulty assessing or measuring the effectiveness of the Objective Force as situational awareness decayed during the campaign. The models used during the wargame lacked the ability to adequately assess the results of lethal and non-lethal space, CNO, and IO activities. In the end, there were numerous insights overlooked (across all domains of military operations) due to the lack of sufficient and relevant models”
Space and CNO Functionality

- Force Enhancement (Warfighter Support)
- Early Warning
- GPS
- Space Weather
- Space-Based ISR
- Space Derived Weather
- SATCOM
- Computer Network Operations (CNO)
- Computer Network Attack (CNA)
- Computer Network Defense (CND)
Space and CNO Functionality (Cont.)

Four key Space Control tasks:
- Protection of Critical Space Systems
- Prevention of Unauthorized Access
- Negation of Hostile Systems
- Surveillance of Space
• Limited space/CNO functionality included in MS&A...including JWARS

• Not all space/CNO mission areas are included at the the desired level of resolution...in any campaign model and few mission models

• Must quantify space/CNO effects at the engineering and mission-level before we can determine campaign-level effects

Some analysis may be required to determine military utility

Essential analysis to determine military utility

Have not shown the military utility
## Who’s Doing Space / CNO Analysis

<table>
<thead>
<tr>
<th>Organization</th>
<th>Area of Study</th>
<th>Method or Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFSA A</td>
<td>Various</td>
<td>Various</td>
</tr>
<tr>
<td>AFSPC ASAC</td>
<td>Various</td>
<td>Various</td>
</tr>
<tr>
<td>JS J8 / IDA</td>
<td>JROC Study</td>
<td>Various</td>
</tr>
<tr>
<td>SMDBL</td>
<td>Army FACT/Various Other</td>
<td>Various</td>
</tr>
<tr>
<td>STATCOM</td>
<td>CNA Analysis</td>
<td>Various</td>
</tr>
<tr>
<td>USACAA</td>
<td>AEIS-ISR</td>
<td>Pol-Mil Gaming</td>
</tr>
<tr>
<td>USMC (Quantico)</td>
<td>Various</td>
<td>Various</td>
</tr>
<tr>
<td>USSPACECOM/AN</td>
<td>GPS, ISR, &amp; BFT</td>
<td>Various</td>
</tr>
</tbody>
</table>

### Resources:

- [http://jcs81.js.smil.mil/](http://jcs81.js.smil.mil/) (includes POCs for some efforts above)
- [http://msrr.afrl.af.mil/MSRR - Classified](http://msrr.afrl.af.mil/MSRR - Classified)
- [http://msrr.afrl.af.mil/MSRR - Unclassified](http://msrr.afrl.af.mil/MSRR - Unclassified)
Required Commitment

Identify space and CNO as a priority of funding for MS&A and MS&A as a priority for space and CNO

Gain commitment among the space and CNO MS&A stakeholders (SPUG, MORS, etc.)

Identify/Develop a suite of models for space and CNO

Identify requirements for space and CNO MS&A (e.g. MOEs / MOPs, algorithms, data, etc.) - SPUG

Imperatives

Limited Models
Limited Funding
Limited Analysis

Restated Problem

Infuse space and CNO into M&S for training exercises

Perform analysis of space-based systems and CNO

The opportunity is ripe to solve the problem with the right commitment

End State

Quantify the added value of space and CNO in joint military ops
Forum of space and MS&A stakeholders gathered to:

⇒ Define requirements for:

✓ Model deficiencies (i.e. suite of space and CNO models)
✓ Data requirements
✓ Algorithms
✓ MOEs/MOPs
✓ Funding requirements

⇒ ..to quantify the military utility of space and CNO in joint military ops through MS&A

⇒ ...by creating a win-win situation for the DoD, joint service, and private/academic sector communities by sharing efforts
SPUG Strategy

- Identify Previous Studies for Space/CNO
  - Archive in MSRR
  - Started Here

- Establish MOEs/MOPs for each Space/CNO Mission Area
  - Ongoing

- Identify Space/CNO Analysis Requirements
  - Analysis (Funding) Strategy

- Space/CNO Requirements Correlation Matrix (RCM)
  - Ongoing

- Establish Data Requirements
  - Ongoing

- Quantify Space Force Enhancement Systems
  - Archive in MSRR
  - End State

- Recognize New Models (VV&A)
  - Develop New Models to Represent Space/CNO

- Identify Suite of Models for Space/CNO
  - Archive in MSRR
SPUG Strategy

- Identify Previous Studies for Space/CNO
- Archive in MSRR
- Started Here
- Ongoing
- Establish MOEs/MOPs for each Space/CNO Mission Area
- Space/CNO Requirements Correlation Matrix (RCM)
- Ongoing
- Establish Data Requirements
- Ongoing
- Identify Space/CNO Analysis Requirements
- Ongoing
- Identify Suite of Models for Space/CNO
- Archive in MSRR
- Identify Space/CNO Courses of Action
- Recognize New Models (VV&A)
- Quantify Space/CNO Courses of Action
- Develop New Models to Represent Space/CNO
- Quantify Space Force Enhancement Systems
- End State
# Req'mts Correlation Matrix (RCM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Force Enhancement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Warning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pos/Nav (GPS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SATCOM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Network Operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attack (CNA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defense (CND)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Review (ongoing) activities since the last SPUG
  – JWARS development
  – JWARS Space Strategic Partner (JSSPAR)
  – DMSO activities
  – Army FACT effort
  – Ongoing analysis efforts
• Make progress toward identifying qualitative/quantitative space/CNO effects for the warfighter
Tuesday, 11 June 2002, Atrium II, Room 120

0800-0900  Welcome/ Intro Brief  MAJ McLagan (USSPACECOM)
0930-1030  JWARS Update  Lt Col McIntyre (JWARS JPO)
1030-1130  JSSPAR Update  Ron Smith (GRCI Corp.)
1130-1330  Lunch  Self
1330-1430  DMSO Brief  LtCol Hadinger (DMSO)
1430-UTC  Army FACT Brief  Mr. Steve Elliott (SMDBL)

Wednesday, 12 June 2002, Atrium II, Room 120

0800-0930  Vignette Brief  Mr. Jim Sheedy (TASC)
0930-1000  Intro to WG Session  MAJ McLagan (USSPACECOM)
1000-1130  MOE/MOP Brainstorming Discussion Working Groups
1130-1330  Lunch  Self
1330-1530  MOE/MOP Brainstorming Discussion Working Groups
## Taskers from Dec.‘01 SPUG

<table>
<thead>
<tr>
<th>Tasker:</th>
<th>POC:</th>
<th>Status as a community:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post briefings/minutes from Dec SPUG (each SPUG)</td>
<td>USSPACECOM</td>
<td>Posted at <a href="http://www.msiac.dmsomil/SPUG">www.msiac.dmsomil/SPUG</a></td>
</tr>
<tr>
<td>ID requirements for space / CNO MS&amp;A</td>
<td>All space MS&amp;A organizations / services</td>
<td>Space MS&amp;A stakeholders need to identify their individual requirements</td>
</tr>
<tr>
<td>Lead and leverage analysis to quantify space / CNO in joint military ops and homeland defense</td>
<td>All space MS&amp;A organizations / services</td>
<td>Stakeholders need to highlight their analytical efforts to quantify the military utility of space and CNO</td>
</tr>
<tr>
<td>Populate and maintain an MSRR for space / CNO analysis activity</td>
<td>All space MS&amp;A organizations / services</td>
<td>Stakeholders need to register and populate the MSRR at <a href="http://cafmsrr.afams.af.smil.mil">http://cafmsrr.afams.af.smil.mil</a> and <a href="http://afmsrr.afams.af.mil">http://afmsrr.afams.af.mil</a></td>
</tr>
</tbody>
</table>
Tasker:
Capture the quantitative effects / measures of space / CNO analysis in the Requirements Correlation Matrix (RCM)

POC:
USSPACECOM (with help from AFSPC, SPUG, etc.)

Status as a community:
Working at June 02 SPUG
<table>
<thead>
<tr>
<th>Tasker:</th>
<th>POC:</th>
<th>Status as a community:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish functionality requirements for each space mission area in JWARS (also applies to other mission &amp; campaign models)</td>
<td>USSPACECOM &amp; JSSPAR / JWARS folks</td>
<td>Ongoing; Being briefed at the June 02 SPUG</td>
</tr>
<tr>
<td>Establish data requirements for space representation in JWARS (also applies to other mission &amp; campaign models)</td>
<td>USSPACECOM &amp; JSSPAR / JWARS folks</td>
<td>Ongoing; Being briefed at the June 02 SPUG</td>
</tr>
<tr>
<td>Perform model runs with JWARS to evaluate space functionality</td>
<td>USSPACECOM &amp; JSSPAR / JWARS folks</td>
<td>Being addressed as a separate effort with the JWARS JPO</td>
</tr>
</tbody>
</table>
This Briefing is
UNCLASSIFIED

Modeling,
Simulation, and Analysis
(MS&A)
Space User’s Group
(SPUG)

11-13 June 2002
Tuesday, 11 June 2002, Atrium II, Room 120
0800-0900 Welcome/ Intro Brief/Review Taskers MAJ McLagan (USSPACECOM)
0930-1030 JWARS Update Lt Col McIntyre (JWARS JPO)
1030-1130 JSSPAR Update Ron Smith (GRCI Corp.)
1130-1330 Lunch Self
1330-1430 DMSO Brief LtCol Hadinger (DMSO)
1430-UTC Army FACT Brief Mr. Steve Elliott (SMDBL)

Wednesday, 12 June 2002, Atrium II, Room 120
0800-0930 Vignette Brief Mr. Jim Sheedy (TASC)
0930-1000 Intro to WG Session MAJ McLagan (USSPACECOM)
1000-1130 MOE/MOP Brainstorming Discussion Working Groups
1130-1330 Lunch Self
1330-1530 MOE/MOP Brainstorming Discussion Working Groups

Thursday, 13 June 2002, Atrium II, Room 120
0800-0930 MOE/MOP Brainstorming Discussion Working Groups
0930-1100 WG Outbriefs Working Groups
1130-UTC Wrap-up/Discussions MAJ McLagan
SPUG Strategy

1. Identify Previous Studies for Space/CNO
2. Establish MOEs/MOPs for each Space/CNO Mission Area
3. Analysis (Funding) Strategy
4. Identify Space/CNO Analysis Requirements
5. Space/CNO Requirements Correlation Matrix (RCM)
6. Establish Data Requirements
7. Quantify Space/Force Enhancement Systems
8. Recognize New Models (VV&A)
9. Identify Suite of Models for Space/CNO
10. Develop New Models to Represent Space/CNO
11. Archive in MSRR

Start Here:
- Archive in MSRR

End State:
- Quantify Space/CNO Courses of Action

Ongoing:
- Archive in MSRR
- Identify Space/CNO Analysis Requirements
- Ongoing
## Requirements Correlation Matrix (RCM)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Force</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhancement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Warning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pos/Nav (GPS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SATCOM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Network Operations (CNO)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attack (CNA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defense (CND)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Vignette Scenario

Mission Area Focus

Space-Based ISR

BFT

Computer Network Attack (CNA)

GPS

Homeland Defense

Joint Military Ops
• Identify a “team leader” (spokesperson) and a “recorder” (i.e. someone who knows Powerpoint)
• We have a reasonable time limit
• Think “outside the box” for space/CNO effects
• Do not evaluate ideas...no idea is ridiculous
• Make bullets self explanatory (e.g. identify acronyms, etc.)
• Can discuss at the SECRET COLLATERAL-level...mark slides appropriately
• Each group will look at each mission area...known as the Delphi method

• End State:
  - Leverage the diverse SPUG expertise to qualify/quantify effects of space/CNO in joint military ops and Homeland Security for the warfighter
  - Capture the knowledge of space/CNO effects (i.e. Space/CNO RCM, MSRR, individual stakeholder databases, etc.)
• Aircraft must fly at a lower altitude to see targets because use of PGMs is degraded
• Can use smaller caliber bomb with improved GPS accuracy
  – Added benefit is minimized collateral damage
  – Another benefit is improved logistics with smaller bombs
• Minimization of Fratricide using more accurate weapons
• Decreased formation time with accurate navigation
• Support for Common Operational Picture through secure communication (timing)
  – Support to BFT and ISR
• Reduced sorties (minimizes attrition)
• Reduced munitions
• Smaller presence required for Force Projection
• Improved standoff capability (TLAM as an example, also JSOW)
• Improved CSAR
• Public opinion--clean warfare with minimum blue force loss, and minimum collateral damage and minimum impact on civil infrastructure
• Support mine countermeasures (MCM)
• Support mine emplacement
• Permits small unit operations in place of large scale operations
• Minimizes many aspects of logistic chain
• Facilitates insertion and extraction of SOF
• Improves secure comm throughput (effective/efficient use of bandwidth)!!!
  – Increased demand on bandwidth due to people asking, “where am I?” over the net
• Supports precision navigation
• More accurate determination of impact point for inbounds
• Synchronization of forces (Precision Maneuver)
• Precise Targeting
• Denial of Red Force use of GPS
  – Slows down military operations
  – Prevents use of precision GPS weapons against Blue Force
• Situational Awareness of Space Assets (knowledge of Blue Force sats)
Effects - Joint Military Ops (Cont.)

• Support quicker and more accurate employment/reemployment of artillery
  - More precise fires thru known location and precision munitions
  - Minimizes Reds counterfire/attack ops
• Support for Nuclear detection
• Support for nuclear attack capabilities
• More effective close air support operations and naval surface fire support
  - flexibility of aerial platforms (multi-role AC = B-52s)
• Time hacks (synchronized ops)
• Red COAs vs. blue GPS infrastructure
  - blue GPS accuracy is severely degraded
GPS Effects - Homeland Security

• Able to track emergency vehicles for crisis response
• Support Digital cellular service
• Provides banking secure comm synchronization
  - ATMs, Securities Trading, International Banking
• Support to critical infrastructure
  - Supports E-911 cellular location capability
  - EMS dispatch and management
  - Wildfire (natural disaster) management (FEMA uses = various uses)
  - Power grid (timing for power transmission across the country)
  - Civil aircraft (private) (route navigation)
  - Package distribution and delivery services (etc.)
  - Commercial shipping (waterway/coastal navigation - e.g. Mississippi)
  - Loss of Internet timing
• Examine denial of GPS to Threat and collateral effects to critical infrastructure
• Reduced fratricide by improved situational awareness of friendly forces
  - improved decision making due to improved SA (improved = more rapid, more accurate)
  - provides a status of forces
• What about dynamic friend vs foe situation?
  - Foe gets ahold of BFT system
  - Lack of allied use of BFT may cause further confusion
• Effective (on time) logistics
• Economy of force (more efficient use of forces)
• Dynamic re-tasking of forces
  - react to changing situation based on improved SA of blue forces
  - fusion of information systems (ISR, BFT, etc)
• May reduce need for ISR analysis of known blue force locations
• Improved targeting by FOs due to real time unit location knowledge
  - provides another control measure in addition to FSCL, etc
• Better AAR capability as a training aid (improved TTPs, doctrine, etc)
• Improved CSAR capability
• Status of forces for emergency response = improved response time
  - wildfires
  - commercial transport (shipping, trucking, etc)
  - reroute for efficient operations
• Monitoring of hazardous cargo
• Better management of (nuclear) security forces
  - contain threats by coordinating blue force response
• How do you integrate BFT into the crisis/consequence management network?
• How do you separate tracking of blue guys turned red?
Identify a “team leader” (spokesperson) and a “recorder” (i.e. someone who knows Powerpoint)

We have a reasonable time limit

Think “outside the box” for space/CNO effects

Do not evaluate ideas...no idea is ridiculous

Make bullets self explanatory (e.g. identify acronyms, etc.)

Can discuss at the SECRET COLLATERAL-level...mark slides appropriately

Each group will look at each mission area...known as the Delphi method

End State:
  - Leverage the diverse SPUG expertise to qualify/quantify effects of space/CNO in joint military ops and Homeland Security for the warfighter
  - Capture the knowledge of space/CNO effects (i.e. Space/CNO RCM, MSRR, individual stakeholder databases, etc.)
• Rapid, low risk battle damage assessment (BDA)
• Intentional spoofing based on known collection times (red and blue capability)
  – Heat signatures from AC, spectral signatures
• Planning strike times (ATO) according to over flight times (have a space tasking order (STO))
  – Coordinate IMINT, SIGINT, MASINT, etc
  – Becomes predictable
• Tracking proliferation based on MASINT
• Determine activity level (increase vs. decrease) based on MASINT signatures (also acoustics)
• Battlespace characterization (situational awareness)
  – Renewed battlespace characterization
• Military ops start due to ISR indications (treaty violation, etc)
  – “Tip off”
  – Across multi-discipline areas
• Mission rehearsal based on situational awareness (“god’s eye” view)
• Classify port capabilities (activity, flow, choke points, etc.)
• Not always space-based ISR systems required to do (HUMINT, airborne sensors, commercial crafts, UAVs, etc.)
  ‒ Collection management between all sensor types (data fusing)
• Work from a adversarial/archaic (caveman tactics) framework
  ‒ Asymmetrical warfare (inflict large amounts of damage at a low cost)
• Interview the postal worker and establish the psychological profile
• Affects target location error for precision engagement
• Use of non-ISR assets for intelligence (Weather Sats)
  ‒ Night time visual imagery
  ‒ Disruptions of weather systems as tipper
    ‒ Natural disasters as model
• Ham radio exploitation
  ‒ Command and control of amateur satellites
  ‒ Support OB and electronic OB
  ‒ Improved response time to a threat scenario
• Calibrate on known spectral signatures (marijuana patches in CA to calibrate for South America applications counter drug ops)
• Change detection of potential attack staging areas against the US (illegal immigrations, etc)
• Locating WMD (weapons, effects, etc) before or after incidents
• Characterization of natural disasters
  - Foliage characterization, crop growth/famine
• Historical database for predicting future events based on past incidents
  - Fusing the data among national agencies, commercial databases (insurance, stock market, etc for “tip off” info
  - Vulnerability of databases to outside attack (CNA)
• Cell phone intercepts (SIGINT)
• Precision navigation in commercial vehicles
  - Correlate private sector info with national databases
  - Real time situational awareness (geo-rectified data) for self and others
  - Tracking long haul trucking/shipping (potential WMD or tracking sensitive loads
• Mission rehearsal to particular scenarios based on known info
• Classify port capabilities and activities (traffic flow, loading, unloading)
  - Applies to red and blue side
• Deceive intel targets influence collection capability
  - As soon as you start observing an action, you start influencing the action
  - drive adversary to a particular COA based on deception/influence
• Use of non-ISR assets for intelligence (Weather Sats)
  - Night time visual imagery
  - Disruptions of weather systems as tipper
  - Natural disasters as model
• Ham radio exploitation
  - Command and control of amateur satellites (threat vs asset to DoD?)

Work from a adversarial/archaic (caveman tactics) framework Interview the postal worker and establish the psychological profile

Improved response time to a threat scenario
This Briefing is UNCLASSIFIED

Modeling, Simulation, and Analysis (MS&A)
Space User’s Group (SPUG)

MAJ Bill McLagan
USSPACECOM
Analysis Directorate
Comm: (719) 554-5122
DSN: 692-5122
Fax: x4070
Email: bill.mclagan@peterson.af.mil
Class: mclaganb@spacecom.smil.mil

11-12 June 2002