Is Space the Ultimate High Ground?

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ABSTRACT

Military experts often refer to space as the ultimate high ground under the premise that placing systems in orbit provides advantages consistent with the military doctrine of high ground. Although space provides the ultimate "observation post", it has none of the other advantages traditionally associated with high ground. Army Field Manual (FM) 34-130 states the other advantages of holding key terrain: commanding avenues of approach, overcoming obstacles, and affording cover and concealment as additional benefits of high ground. Yet systems in orbit incur none of these additional advantages. Finally, international restrictions and reciprocity concerns limit the employment of weapons in space nullifying many of the unique capability advantages that would otherwise support the "high ground" aspect of space.

As the ultimate observation post, satellites provide a large quantity of vital data to military decision makers. This massive amount of data needs to have as much context as possible to convert this data to useful knowledge. To use space assets optimally, the military needs to learn from the past and make space and cyber products distributed and tactical. It is absolutely essential to distribute the right information to the lowest level (tactical elements) of the organization or the "boots on the ground" in a timely manner.

Keywords: Space, observation, intelligence, surveillance, reconnaissance, information, context, knowledge.

1. INTRODUCTION

Space has been frequently dubbed "the ultimate high ground". Merriam-Webster defines high ground as a position of advantage or superiority. To thoroughly analyze this statement from a military perspective, a West Point Academy professor cited Army Field Manual (FM) 34-130 as the best source to discover what the Army is looking for in key terrain or high ground. Army officers are instructed to perform Intelligence Preparation of the Battlefield (IPB) and understand the benefits of key terrain such as high ground and do a thorough analysis prior to the commencement of military operations [1].

To determine if space is the ultimate key terrain or high ground, one must determine if systems in space orbit meet the criteria of Army FM 34-130. Specifically, IPB considers observation and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach. Many Army officers use the mnemonic OCOKA to remember these terms.

2. SPACE AS KEY TERRAIN

Does space confer the advantages consistent with those a soldier is looking for when performing IPB? Does a position in space provide observation of the battlespace, prevent adversaries from using that position as key terrain, represent an obstacle to movement within space, command the avenues of approach, or provide any cover and/or concealment?

2.1 Observation

Mankind has always been looking for higher and higher observation posts. Trees and mountains were not always sufficient in ancient times, so watchtowers were constructed to allow sentries to see and communicate farther and thereby provide advanced warning of enemy troop movements and attacks. Roman watchtowers still survive to this day that confer sweeping views of the surrounding terrain.

During the American Civil War Thaddeus Lowe used hot air balloons to gain valuable intelligence for the Union Army in numerous battles. The use of observation balloons continued in World War I where many brave individuals ascended to over a thousand feet in hot air balloons with a parachute as their primary safety device in order to collect valuable

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intelligence. Not so coincidentally, one of the more important air missions in World War I was to shoot down enemy balloons to prevent the gathering of this intelligence.

After balloons, the next major advance was the airplane. The first military application of the airplane was for reconnaissance. The U-2 and SR-71 were integral parts of a long history of airborne reconnaissance platforms. The U-2 was reputed to be out of the reach of any threats and allowed pilots to collect imagery with no fear of reprisal.

Satellites followed airplanes as better and higher reconnaissance platforms. Many movies have glamorized the ability of modern satellites to provide detailed and immediate intelligence. In the popular series 24, the importance of satellite imagery to Jack Bauer and the Counter Terrorism Unit was demonstrated over and over. There is no disputing orbital satellites are the ultimate observation platform.

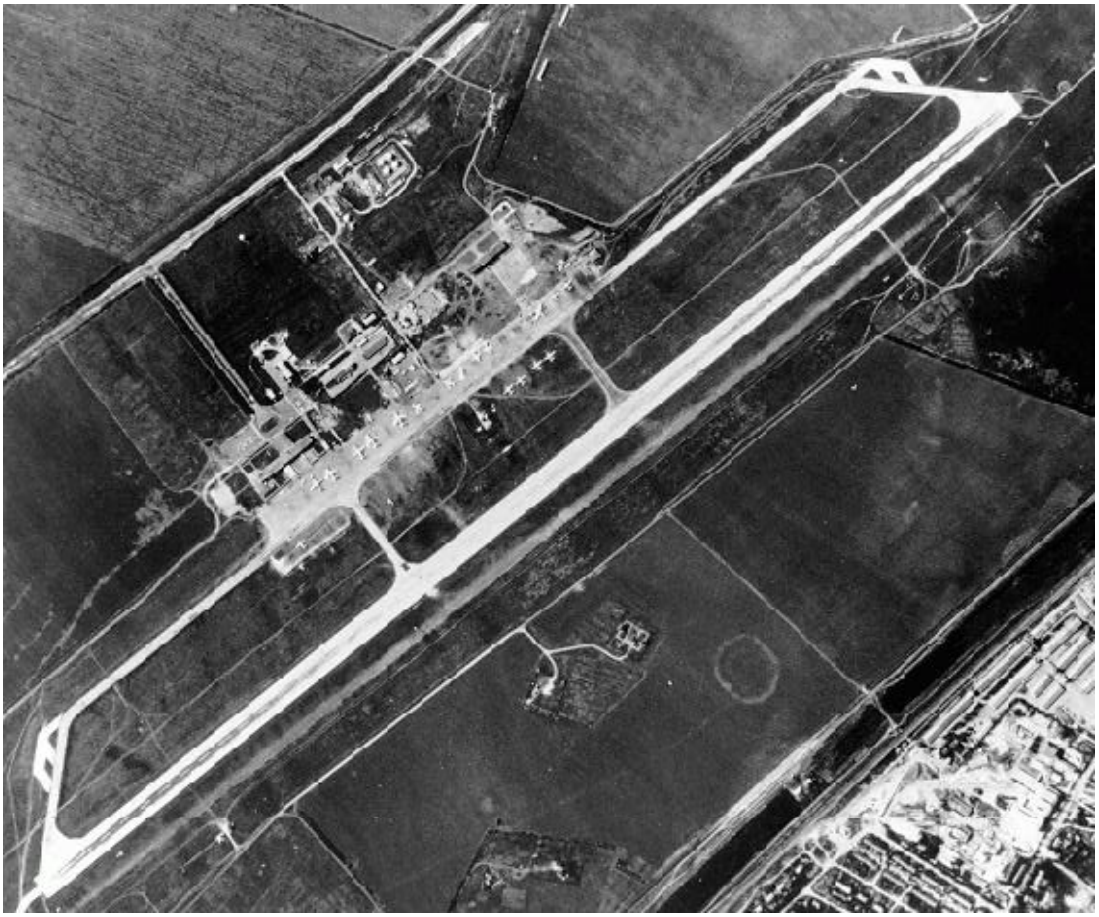

Figure 1. Corona 4 imagery of a Soviet airfield (1962). The resolution of early satellite imagery was measured in meters, the resolution of modern satellite imagery is measured in millimeters.

2.2 Fields of Fire

Army FM 34-130 also considers fields of fire with observation. Satellites confer incredible fields of fire, but this is somewhat irrelevant as the "weaponization" of space is politically problematic. The Outer Space Treaty prohibits weapons of mass destruction in space or on any celestial body. In 2001, the UN passed a nonbinding resolution that went 156-0-4 in favor of keeping space free from weapons. Nevertheless, the U.S. government position is somewhat

ambiguous when it comes to putting weapons in space. The U.S. has carefully left the door open to the possibility of using space to take action against adversaries.[2]

2.3 Concealment and Cover

Concealment is protection from observation. Cover is protection from direct and indirect fires. Systems in space are not under cover or concealment in any way. It is quite easy to go to the internet and find the orbits of many satellites or even use a cell phone application to locate the exact positions of overhead satellites.

Name of Satellite	Country of Owner	Operator/Owner	Class of Orbit	Perigee (km)	Apogee (km)	Eccentricity
AAUSat-2	Denmark	University of Aalborg	LEO	613	636	1.64E-03
AcrimSat	USA	NASA,Jet Propulsion Laboratory	LEO	682	727	3.18E-03
AEHF-1	USA	US Air Force	GEO	4,732	49,970	6.71E-01
⋮						
Zhongxing 20A	China (PR)	People's Liberation Army (C41)	GEO	35,773	35,799	3.08E-04
Zhongxing 22A	China (PR)	Chinasat	GEO	35,767	35,807	4.74E-04
Zhongxing 9	China (PR)	Chinasat	GEO	35,759	35,812	6.29E-04

Figure 2. List of satellites in orbit [3].

Donald J. Kessler, a NASA scientist, mentioned in 1978 that collisions in Low Earth Orbit (LEO) could create space debris that lead to more and more collisions. The most apocalyptic scenario would leave the entire low earth orbit filled with space debris and the use of LEO satellites would be precluded for generations.

2.4 Obstacles

Obstacles are any natural or manmade terrain features that stop, impede, or divert military movement [1]. Except for existing satellites and space debris, space is relatively free from obstacles. After the initial energy needed to put objects in space, they can orbit the earth at high velocities for a long period of time.

2.5 Key Terrain

Do space orbits count as key terrain? Is there an advantage to being first to gain a strategic orbit? Although being the first to get to a particular geosynchronous orbit may confer “squatter’s rights” of some sort, the number of strategically equivalent orbits is endless. Imaging satellites have an incredible field of view, and having to lag or lead an existing satellite by a safe margin is not a significant problem.

2.6 Avenues of Approach

An Avenue of Approach is an air or ground route of an attacking force of a given size leading to its objective or to key terrain in its path [1]. The avenues of approach to the objective in space (orbit) are free from threats. Unlike when a military commander achieves the high ground and seriously impacts his adversaries safety and freedom of movement, achieving orbit does not impact the safety and freedom of movement of later satellites achieving orbit.

2.7 Space is not the ultimate high ground

Space, then, is not the ultimate high ground. Systems in orbit do not command avenues of approach, overcome obstacles, shelter under cover and concealment, or hold any key terrain advantage over other space systems. Space is the ultimate observation post, but we cannot take advantage of the incredible fields of fire from space due to international

norms and reciprocity concerns. Space provides an incredible source of Intelligence, Surveillance, and Reconnaissance (ISR) products. The data produced from space systems has a staggering quantity and accuracy, but care has to be taken to avoid "data overload".

3. WE NEED MORE CONTEXT AND KNOWLEDGE

How do we avoid "data overload"? Dr. Edward Tufte has stated, "We are awash in data. If we're lucky and can imbue it with some relevance, that data becomes information. And there is still too much of it. Not until we can imbue information with context can we turn it into knowledge."[4] As we move to more accurate time and position information about millions of targets around the globe, we need to make sure that we maximize the context of this information and consequently maximize the knowledge this information contains.

A famous French cartographer, Charles Joseph Minard, depicted Napoleon's march on Moscow in a chart in 1869. This chart depicted the number of troops along the march, the distance and times along the march, relevant terrain features, and the temperature along the March all on a single chart. If satellite imagery was available then and had detailed information on the exact position and time of every soldier in Napoleon's army on this march, would this add more knowledge to Minard's chart?

IBM developed a computer named Deep Blue that was able to defeat the best human chess player. This year IBM developed a computer named Watson that was able to win at Jeopardy. The ability of computers such as Deep Blue and Watson to sort through a multitude of data and provide the best chess move or answer to a Jeopardy question proves that computers can help us with our mass of data. We just need to make sure we preserve the context.

In the popular Hitchhikers Guide to the Galaxy series by Douglas Adams, computers were asked to find the Ultimate Answer to the Ultimate Question of the Life, the Universe, and Everything. After 7.5 million years the computer found the answer to be 42, but after 7.5 million years the original question was forgotten. Obviously without the context of the original question, the answer is meaningless.

In our quest for more and better data we need to ensure that we do not lose the context of the ultimate question with the ultimate answer.

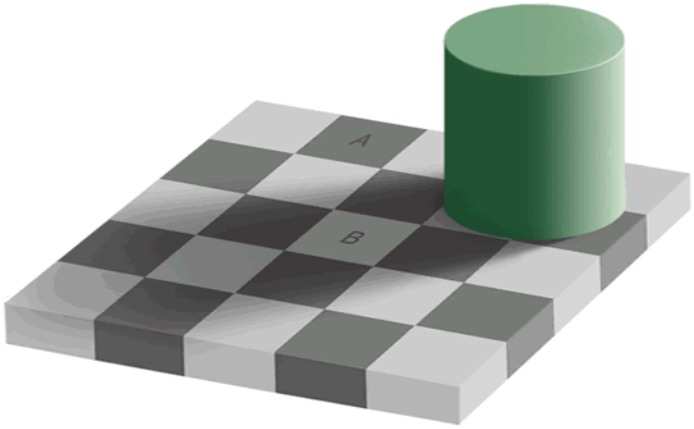

Figure 2. Optical illusion that demonstrates the importance of context. What square is darker, A or B? They are both the same shade, but B appears lighter because of the perceived context: it is in the shadow and is expected to be part of the light squares of a chessboard. [5]

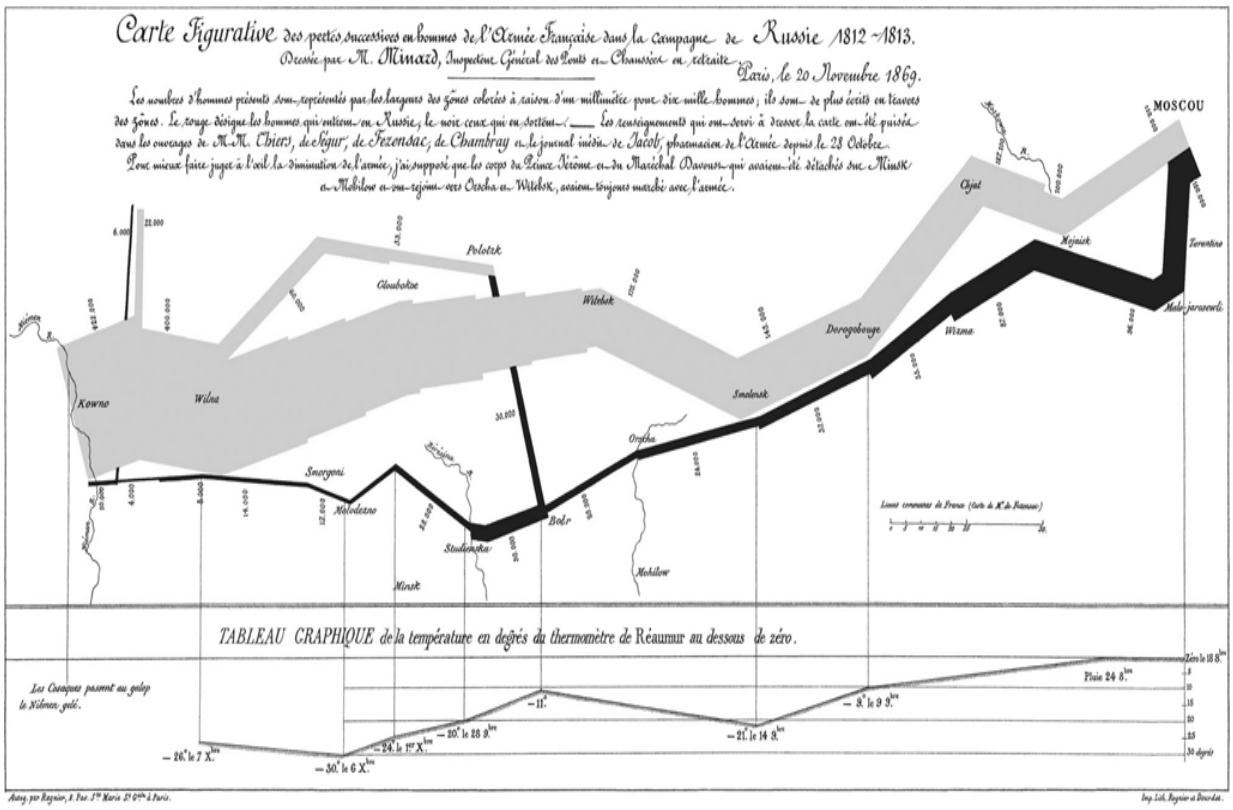

Figure 3. Charles Joseph Minard, depicted Napoleon's march on Moscow in this chart originally published in 1869. Number of troops, time, temperature, distance and relevant terrain features are all conveyed.

4. ON THE SOAPBOX – A VISION FOR SPACE AND CYBER

As we struggle with integrating two battle domains with the traditional air, land, and sea domains, it is important that the Air Force lead the way in leveraging operations in air and cyber. The U.S. military cannot afford a prolonged struggle over space and cyber as we did when the services argued over the air domain after the birth of Air Force. It was obvious that air operations were critical to every service, but the fight over the control of air assets and dollars was not productive. In the end the Navy had carrier aviation, the Army a capable helicopter force, the Marines combined air operations, and the Air Force a huge Strategic Air Command with a nuclear mission. Our history of performing joint air operations has been checkered at best.

The services can erase this blemish on our joint operations record by integrating space and cyber operations in a true "network centric" manner. The Air Force has the de facto lead in space and cyber just as they had the de facto lead in air. Only by truly understanding the Intelligence, Surveillance, and Reconnaissance (ISR) products from these domains are essential to every service and even to the other instruments of national power (diplomatic, intelligence, and economic) and by distributing these products to everyone that need them, will the true potential of these domains be realized. It is now obvious that precise position and time information on "targets" all over the world can be passed in real time over data networks anywhere in the world. The Air Force should ensure that these vitals products be distributed and tactical.

By distributed, we mean these products need to be available to all consumers of this information with a valid need-to-know. After 9/11 we realized the need to make sure information reaches those that need it, and after "Wikileaks" we learned it is still important to make sure only those that need classified intelligence get it. The current classified network

currently used by the military (SIPRNET and JWICS) are inadequate for this task. A new distributed network architecture capable of passing massive quantities of information to a rapidly changing set of consumers is indicated. It is critical to think outside our services and even outside the DoD.

By tactical, we mean these products need to go below the strategic and operational level to the bottom of the organization chart. The marine patrol in the field needs to be able to have critical ISR information available on the classified equivalent of a smart phone. These products need to be processed in such a manner that tactical users get the information they need. It is reasonable for a foot patrol to have access to the latest satellite imagery of the area they are to patrol to cover possible ambush and interdiction points.

To achieve this vision of distributed, tactical space and cyber products, systems engineering needs to be better institutionalized across the enterprise. A distributed network cannot be achieved if the service pieces of the network do not talk to each other or communicate in common data formats. Fortunately, cyber standards are not fully codified and much of space has yet to fully evolve. There is time to lead the development of space and cyber standards. It will be difficult for the services to cooperate in this endeavor as evidenced by the problems agreeing on the requirements for the Joint Strike Fighter, but this should not dissuade the Air Force. As the premiere Subject Matter Experts in space and cyber, the Air Force has the credibility and charter to truly open standards for space and cyber networks that enable the creation of a truly "plug and play" architecture.

The Air Force has tendency to stay at the Air Operations Center (AOC) and expect the other services to come to them (see Figure 3). During the Vietnam War the Air Force concentrated on using air for strategic interdiction missions. When the Air Force commanders had control of all the theatre air assets to include Marine aviation, they tended to ignore the Close Air Support (CAS) missions the supported marine commanders demanded and that the marine aviators were best suited to perform. Many marine commanders were dissatisfied in the lack of a tactical focus of the Vietnam air campaign.

Just as it is difficult to lead from behind a desk, it is difficult to support a precise, coordinated operation from the AOC. In the drive on Baghdad in Desert Storm 2, the 4th ASOC supported V corps by moving the AOC into the field. The air campaign was superbly coordinated with the ground campaign and many tactical targets were engaged shortly after being identified. This model needs to be extended to space and cyber operations. The space forces cannot expect everyone to come to Colorado, but need to push space support into the field. Just as we have Theatre Air Control Parties (TACPs) supporting air operations imbedded in operational units, we will need equivalent space and cyber troops as well.

Figure 4. OPERATION IRAQI FREEDOM -- Controllers in the Combined Air Operations Center at an air base on the Arabian Peninsula monitor the status of ongoing missions supporting Operation Iraqi Freedom. The CAOC was the nerve center for all U.S. Central Command air operations when the first air strike occurred early March 20, 2003. Cruise-missile attacks and the start of massive air operations with thousands of sorties a day followed this opening strike. (Photo by Ministry of Defence-Royal Air Force Sgt. Gareth Davies) [6].

USSTRATCOM has the lead in cyber, but it is important to understand the true differences made in space and cyber will be felt at the operational and tactical levels as well as the strategic level. Just as the Air Force had the tendency to grab all air assets and use them for strategic "interdiction" type missions, the space and cyber HQs must avoid the temptation to perform all strategic space and cyber missions. The next war will not be a conventional one, and we have learned that strategic effects are not helping in the future asymmetrical and irregular wars. I predict "tactical" effects will be much more useful in the next counterinsurgency operation than strategic ones.

5. CONCLUSION

There is a great opportunity for the USAF to lead the way to integrate the space and cyber domains into the next level of joint warfare. To make space and cyber effective, the ISR products developed must be distributed to a wide network that includes all DoD and supporting instruments of national power as well as being of a tactical nature that is useful at the lowest levels of the fighting commands. The space and cyber commands need to leave the operations center and support the warfighter with relevant and timely information. Our network architecture needs to be revamped to support the rapid dissemination of massive amounts of data to the consumers that need it.

Although space is not the "ultimate high ground", it is a font of the best ISR products ever developed. We need to make sure we get the most out of it.

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