Viewpoints

Motion Intelligence and Air Power: A Concept

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Introduction

The conceptual foundations laid for the Royal Air Force by Viscount Trenchard, widely described as 'Father of the Royal Air Force', continue to this day.[1] However, these concepts have continually evolved. Technological advances and the perceived threat from potential adversaries determine the scale and direction of this evolution. The second strategic priority in the *RAF Strategy 2006* stated the need to develop an expeditionary air power capability 'which takes full account of emerging threats, concepts and technologies'.[2] One of the key strategic priorities in the forthcoming *RAF Strategy 2012* expressly stipulates the need to 'remain at the centre of the conceptual thinking on air power to ensure the exploitation of new ideas and technology to influence others'.[3] In an air force of decreasing size, with less manpower, less aircraft and squeezed budgets, as well as an enduring high operational tempo, the need to ensure that conceptual thinking remains at the forefront of the application of air power has seldom been greater. Thus, this article proffers a concept called 'Motion Intelligence'. It is not just about intelligence. It is about a type of intelligence collected from, acted upon, and facilitated by, air power.

A brief note is required on what this article aims to achieve. Firstly, it will demonstrate the importance of motion as a source of intelligence alongside an image, a signal, and a human agent. Secondly, it will demonstrate the importance of the height and reach provided by air power in the collection of Motion Intelligence. Thirdly, it will recount the technological developments that have facilitated this type of intelligence collection. Importantly, this article is not about procurement or a specific platform. Neither does it advocate the importance of one type of intelligence over another. In fact it is not just about British capabilities but includes the ability to detect motion beyond the British inventory. This article is also acutely aware of the limitations of technical collection in understanding the 'social terrain'; there is only so much that can be understood using sensors from air and space platforms.[4] It is about a concept first and foremost. At the very least, it is hoped that this article will demonstrate the value of air power in detecting motion as an intelligence source, and highlight its value within the mind-set of operational planners.

This article will initially explain what is meant by Motion Intelligence and a definition will be provided. Analysis of the historical and current application of Motion Intelligence will then be presented. This analysis will demonstrate that Motion Intelligence is not a new concept; it has been at the very heart of air power – and indeed warfare in general – since time immemorial. Delving into history is an appropriate and important precursor to advocating a 'new concept'. Finally, this article will look to the future of Motion Intelligence and how this concept may evolve. The proposition of this article is that motion is a valuable source of intelligence and that technological advances over the past decade or so have been revolutionary enough to warrant a category of its own. In a similar way to the re-organisation that occurred following technological innovations that facilitated the collection of imagery and signals, it is important to continually re-assess how we categorise, organise and implement our intelligence. Recent technological advances in our ability to detect motion warrant such a re-assessment.

What is Motion Intelligence?

Motion Intelligence could be defined as 'intelligence acquired from targets moving in either the air, land or sea environment'. Or to put it more succinctly, it could be defined as 'intelligence gleaned from that which moves'. For simplicity, the author prefers the latter definition. As an acronym, MOTINT seems suitable. Primarily, therefore, MOTINT is about detecting the movement of a particular object and using this as a source of intelligence. This has obvious applications during conflict. Knowing where one's enemy is located is one thing; knowing when they leave this location, in what strength, in what direction they are travelling, how fast they are travelling, in what formation they are travelling, and when they arrive within striking distance of one's own forces, are all vital pieces of intelligence for any military commander.

The ability to collect MOTINT using modern sensors has dramatically changed how modern air forces operate. Detecting, tracking and attacking a moving target with any degree of accuracy is a relatively recent development. This development was encapsulated in an Adelphi Paper, *The Revolution in Strategic Affairs*, written by Professor Sir Lawrence Freedman in 1998. In this publication, Professor Freedman stated:

> The major proposal of the early 1980s was concerned with deep strikes to the enemy rear, against fixed targets, such as bridges or airfields, and so played to the new technology's known strengths. There was far more scepticism about being able to track and attack with much accuracy anything on the move.[5]

Modern sensors that are able to detect motion fall into two distinct categories: motion imagery and Moving Target Indication (MTI). Broadly speaking, motion imagery includes any imaging sensor – whether Electro-optical (EO), Infrared (IR), Multi-spectral (MSI) or Hyper-spectral (HSI) – that collects imagery at a rate of one frame per second or faster.[6] Motion imagery is not just about Full Motion Video (FMV), although this is probably the most well-known and most prolific type of motion imagery sensor. Motion imagery also includes those sensors that cover a wider area and fall under the NATO designation of Large Volume Streaming Data (LVSD).[7] LVSD systems are more commonly referred to as WALF (Wide Area Large Format), WAMI (Wide Area Motion Imagery), WAPS (Wide Area Persistent Surveillance) and WAAS (Wide Area Aerial Surveillance).[8] An article in *Jane's Defence Weekly* in August 2011 stated that wide-area motion imagery sensors 'are able to provide coverage of large areas of terrain and, in some cases, allow an operator to select a specific target and track it across the sensor's entire field-of-view'.[9]

MTI uses radar propagation to identify and locate a moving target.[10] There are different types of MTI: Ground MTI (GMTI) which is commonly used to refer to the detection of vehicles, but with an additional capability to detect surface vessels in the maritime environment; and Dismount MTI (DMTI) which is used to refer to the detection of individuals on foot that have a much lower radar cross section.[11] Current systems that can collect this type of intelligence include the Sentinel R1 of V(AC) Squadron, E-8C Joint STARS of the USAF, the Royal Navy's Mk 7 Sea King Airborne Surveillance and Control (SKASaC) helicopter, Northrop Grumman's Vehicle and Dismount Exploitation Radar (VADER), the US Navy's P-3 Orion Maritime Patrol Aircraft, among numerous Remotely Piloted Air Systems (RPAS) that also carry an MTI sensor.

A fundamental question that needs to be answered is where would MOTINT 'sit' in today's intelligence construct? Intelligence has repeatedly been re-categorised following advances in technology. Imagery Intelligence (IMINT) started with rudimentary photography during the First World War, but it came of age during the Cold War with the development of satellite technology and there is now a national imagery centre. Signals Intelligence (SIGINT) initially began as the Government Code and Cypher School, but it gained pre-eminence during the Second World War and is also now a national agency. The categories of Radar Intelligence (RADINT), Acoustic Intelligence (ACINT) and Measurement and Signature Intelligence (MASINT) were also adopted as a result of specific technological advances, but these are abstract terms rather than specific agencies.[12] Open Source Intelligence (OSINT) is a recent development that has been facilitated by the information and communication revolution of the current age, but it is pervasive across all agencies.

So, where do the new technological innovations that detect motion fit into the current organisational construct? FMV is analysed by imagery analysts and 'sits' within the IMINT category. According to *JWP 2-00: Joint Operational Intelligence*, MTI should be categorised as RADINT because it uses radar;[13] but which agency 'does' RADINT? Or, as others suggest, is MTI actually IMINT and therefore should be co-located with imagery? Some have suggested that MTI is MASINT but, according to the definition in *JWP2-00*, MASINT is based on emissions and therefore this does not apply to MTI.[14] Or, is it suitably different enough to be categorised as something completely unique? How would other wide-area motion imagery capabilities be incorporated into the current construct? How is SIGINT – which also incorporates an element of motion – correlated with MTI and motion imagery in today's organisational construct?

Answers to these questions are not superfluous. The answers dictate how we organise our intelligence. At the practical level they determine which categories of 'Int' are co-located into a particular building. Moreover, they determine what storage capacities, connectivity and analytical exploitation tools are provided to enable a specific 'Int'. Thus, in a similar way to the major re-organisation that occurred after the developments of IMINT and SIGINT, is it necessary to acknowledge that the technological innovations that detect motion also require a re-categorisation of our intelligence?

Historical Development / Operational Application

It is important to emphasise that motion as an intelligence source is not a new concept. Military Commanders throughout history have always tried to obtain advanced warning of the movements of their adversary. The sensors able to detect an adversary's movements may have developed, but not the concept itself. This section, therefore, emphasises continuity as much as it does change. The main changes, however, have primarily been the result of technological advances in the height and reach of air power. The ability to reconnoitre higher and over a greater distance was, is, and will continue to be, game-changing. Moreover, the technological developments in the sensors that could be utilised from these new flying machines have also been and will continue to be game-changing.

For an army, the professionalised ability to observe the enemy's movements is encapsulated by the Scoutmaster, a man appointed to 'discover the whereabouts and intentions of the enemy'.[15] As described by King Henry VIII in 1518:

> It is the office of the Scoutmaster when he cometh to the field to set and appoint the scourage, he must appoint some to the high hills to view and see if they can discover anything. Also the said Scoutmaster must appoint one other company of scouragers to search, and view every valley thereabouts, that there be no enemies laid privily for the annoyance of the said camp.[16]

But the scoutmaster was restricted by the highest vantage point to which he could locate his scourage. To overcome this limitation, Jacques Charles invented the hydrogen balloon (or the 'Charliers') in 1783. From an improved vantage point high above the battlefield the importance of this new invention for reconnaissance was obvious. He immediately set about advocating its military application by emphasising that they 'could be made very useful to an army for discovering the positions of its enemy, his movements, his advances, and his dispositions'.[17] The invention of the aeroplane and subsequent technological advances further revolutionised the way in which an adversary was reconnoitred. The Italo-

Turkish War of 1911-1912 provides one of the first examples of aircraft deployed to collect MOTINT. Fighting against Ottoman dominance of North Africa, Italy deployed a large army, a considerable navy, and a handful of aircraft. The Italian pilots recorded the first wartime use of wireless air-to-ground and ground-to-air communications in their mission 'to reconnoitre the flanks and spot ambushes ahead of time'.[18]

Aerial reconnaissance during the First World War also demonstrated the importance of height and reach in detecting motion. Despite General Haig's admonition of the Royal Flying Corps (RFC) in 1914, the first commander of the British Expeditionary Force (BEF), Sir John French, recognised its value. He stated that the RFC had 'furnished me with the most complete and accurate information, which has been of incalculable value in the conduct of operations'.[19] One of the best examples of MOTINT in the First World War is found in aerial reconnaissance of the movements of German forces in August and September 1914. It was a French aviator, Lieutenant Watteau, flying north of Paris who confirmed that German columns had indeed altered course and were not heading toward Paris.[20] The importance of the RFC in collecting MOTINT is further demonstrated by the following extract:

> In the first weeks of the War, when the manoeuvrings of the ground forces were relatively fluid, RFC aircrew were utilised as the eyes of the army…These missions soon proved their worth and were the source of much useful intelligence. Attempts by the German Army under General Alexander von Kluck to outflank the British were detected from the air, enabling the BEF Commander, Sir John French, to escape the trap and earn glowing praise for the RFC.[21]

The use of air power as the 'eyes' for an army was not just confined to the First World War. The contribution of the First Aero Squadron to the Mexican Punitive Expedition in 1916 also demonstrated the importance of reconnaissance through the detection of motion. The First Aero Squadron, equipped with the JN-3 or the "Jenny", was tasked to detect the movements of guerrilla forces led by Pancho Villa that regularly made forays into American territory from Northern Mexico.[22] Another example is provided by the First Air Squadron, operating the DH-4B, which deployed to the Dominican Republic in 1919 to support the US Marines who were tasked to protect American interests in the midst of a civil war. The crews were able to observe the movements of the guerrillas and provide intelligence on their current location and direction of travel that subsequently 'guided patrols to contact with the guerrillas'.[23] This was an early example of air-land integration and it represents a clear example of the provision of MOTINT by air power.

The Battle of Britain is an example of MOTINT *par excellence*. In the mid-1930s a technological innovation was being developed that would enable persistent, wide area surveillance to be conducted for the first time. The name Watson-Watt is synonymous with the technique of Radio Direction and Ranging, or radar. Radar was incorporated into a system of air defence, under the command of Sir Hugh Dowding, which also included fighter aircraft, the ack-ack guns of the army, the Observer Corps, barrage balloons and the air-sea rescue service.

The Chain Home and Chain Home Low stations along the British coastline provided enduring temporal persistence and vast spatial coverage for the collection of MOTINT. Across a vast geographical area, radar enabled the operators to locate the German aircraft, estimate the numbers of aircraft in a particular raid and track their flight path. Based on this information, it was possible to predict targets that the Luftwaffe was planning to attack and to subsequently scramble the most suitable RAF Squadrons and vector them toward the approaching aircraft.

The value of radar and MOTINT in this context is not just in its ability to provide advanced warning of an approaching air raid by the Luftwaffe. The real value of MOTINT was that it allowed an RAF with scant resources an economy of effort from which to win the Battle of Britain. Instead of Squadrons of Spitfires and Hurricanes patrolling Britain's skies without any semblance of purpose, the collection of intelligence through the motion of the Luftwaffe enabled the integrated air defence system to apportion assets to specific threats as they emerged. When there was no threat, the Squadrons of fighters remained on the ground. When a threat was detected, the squadrons were scrambled to a specific intercept. It was not always perfect and the intercepts were not always successful. But, the ability to allocate fighters to a specific threat through MOTINT, in both time and space, enabled an economy of effort for Fighter Command.

The utility of air power and the value of radar were also important in the collection of MOTINT in the naval environment. Prior to radar, air power relied on a visual search by aircrew to detect the location and movement of the enemy's fleet. However, technological advances enabled the capability provided by the massive masts of the Chain Home system to be incorporated onto an aircraft. Air-to-Surface Vessel (ASV) radar was in development in the late 1930s.[24] The first British airborne radar was flown in August 1937 on an Avro Anson. Tests confirmed that it was capable of tracking the movements of Royal Navy vessels. It even detected aircraft taking off from HMS Courageous. Operationally, it was installed on Coastal Command aircraft throughout the Second World War to detect, track and facilitate offensive action against German vessels and submarines. By 1943 the capability of ASV radar improved as advances were made in range and fidelity of detection. It was decisive in the Battle of the Atlantic as German submarines could be located and tracked with greater accuracy when they surfaced, even at night.[25] The ASV radar was also used by Wellington bombers operating from Malta to track Axis shipping supplying Rommel's forces in North Africa.[26] It was also used by long-range Catalina aircraft patrolling the Pacific to track the movements of Japanese shipping.[27] In a similar way to the use of MOTINT in the Battle of Britain, the introduction of radar in the naval environment enabled a more efficient use of resources, an economy of effort, and, importantly for targeting the German submarines, a concentration of force in both time and space.

Technology has further enabled the coverage attained by the Chain Home system to be incorporated onto an aircraft for surveillance in the air environment. The E-3D Sentry is employed in the Airborne Warning and Control System (AWACS) role to provide early warning of air threats. In much the same way as the Chain Home system, it can identify the movements of an enemy's air force and control friendly aircraft in their fight to maintain control of the air. In some respects, it could be argued that the E-3D employs radar in an Air MTI (AMTI) role as a MOTINT asset. To further elaborate on what an AMTI capability incorporates, it could also be argued that the Principle Anti-Air Missile System on board the Royal Navy's Type-45 destroyer relies on an AMTI capability to track and counter air threats. Indeed, any early warning system, including a ballistic missile early warning system, is a further example of MOTINT through AMTI.

The analysis now turns to the detection of motion in the land environment. It was the outcome of the 1973 Arab-Israeli War and the threat from the Warsaw Pact that spurred US military planners to procure a system capable of detecting the motion of an adversary's land forces.[28] The decimation of Arab and Israeli fielded forces in 1973 by the lethality of new battlefield technologies demonstrated the need to know the exact movements of an enemy's front lines, its reserve forces and supply lines, as well as to detect when a course of action was being pursued. Identifying the enemy's advance through superior battlefield information and re-orientating one's own forces against this advance to ensure success was deemed essential. Thus, the US began the development of Joint STARS to provide superior battlefield information through the collection of GMTI. This would prove a revolutionary development in the collection of MOTINT.

It was during the 1991 Gulf War that GMTI was first used in a combat role. Two Joint STARS aircraft deployed to the region despite still undergoing considerable developmental testing. It was a new capability and many operational planners lacked an awareness of the platform's capabilities and limitations. Nonetheless, GMTI provided a unique viewpoint of the battlefield previously unseen. It was during the Battle for Al Khafji that GMTI information was most useful. During the Battle, Coalition air forces used GMTI information to locate, track and cue other platforms to attack and destroy the Iraqi ground forces when they were advancing toward Coalition ground forces.[29] Military planners also used GMTI to determine that the Iraqi ground forces' advance was not a deception for another advance but it was actually the main thrust toward the Coalition; this enabled the Coalition to achieve an overwhelming concentration of force against this attack without having to worry about other possible attacks.[30] In a broader sense, GMTI also provided intelligence on the Iraqi ground forces as they re-orientated and moved locations. This intelligence facilitated offensive air operations against these new positions.[31] Toward the end of the conflict, as Iraqi forces withdrew from Kuwait, GMTI was also the 'source of timely, reliable information that enabled air attacks to disrupt the Iraqi retreat'.[32]

Many US military leaders directly recognised the importance of GMTI during the 1991 Gulf War. Brigadier John Stewart, the Army's Senior Intelligence Officer, stated that 'Joint STARS was the single most valuable intelligence and targeting system in Desert Storm'.[33] General Walter Boomer, Commanding General, 1st Marine Expeditionary Force, noted that 'intelligence began to improve with information that came from JSTARS'.[34] Finally, General Merrill McPeak, Air Force Chief of Staff, stated: 'Never again will we want to go to war without some kind of Joint STARS capability'.[35]

Despite this vindication, only 8 years later operational planners neglected this once-prized capability. Joint STARS was eventually deployed to Kosovo as part of Operation Allied Force in 1999, but it was not included from the start of the campaign. Due to the rugged terrain, the dense foliage, the complicated situation on the ground, the commingling of Serb forces with civilian traffic, the paucity of available aircraft and issues over basing, the contribution of Joint STARS was initially limited.[36] However, it was eventually gainfully employed.

> Fighter pilots came to recognise that the system "changes the rules" because its ability to detect, locate, and track vehicular movements reduced the need for an inefficient visual search…This allowed such assets to be more effective and efficient in finding, identifying, and targeting Serb forces.[37]

GMTI information was once again used to ensure an economy of effort and a concentration of force during the initial stages of Operation Enduring Freedom in 2001 and Operation Iraqi Freedom in 2003. In Afghanistan, GMTI was used to cue other motion imagery assets onto suspected Taliban and al-Qaeda forces as they fled from the advancing Northern Alliance units. The GMTI information covered a large area and could apportion other motion imagery assets accordingly in order to monitor suspect tracks and identify whether it was hostile or civilian. This provided an efficient use of resources and a concentration of force when required. In Iraq, GMTI also enabled air power to be concentrated in both time and space against manoeuvring Iraqi ground forces.[38] In *The Age of Airpower*, Martin Van Creveld wrote:

> Directed to their targets by means of satellite and JSTAR aircraft, using the most up-to-date equipment, the Coalition aircraft rained down air-to-ground missiles while also using their cannon for strafing.[39]

More specifically, SKASaC collected 'pattern of life' MTI data in Iraq before 3 Commando Brigade's amphibious assault on the Al Faw peninsula.[40] This provided excellent situational awareness of the peninsula, including major routes, areas of heavy traffic and Iraqi force dispositions. MTI data continued to be provided to the Royal Marines during their advance in order to inform them of moving targets along the peninsula.[41]

Counterinsurgency operations in Iraq and Afghanistan have demonstrated the value of MOTINT outside of a traditional war fighting scenario. Motion imagery has been used extensively by ground forces to monitor activity at a designated compound, along routes with regular IED activity, of known insurgent bed-down locations, of the movements of known insurgents, and also in the role of over-watch of a patrol or convoy for force protection. In particular, it is well-known that motion imagery has repeatedly identified suspicious activity at the side of a road or other vulnerable points, which has indicated the 'digging-in' of an IED.[42] In May 2012 motion imagery identified and tracked a large number of insurgents preparing to conduct an ambush along Highway 1 in the vicinity of Gereshk.[43] Also in May 2012, a Reaper from 39 Squadron was tasked to assist ISAF forces manning a Check Point in Nad-E Ali that had come under fire from insurgents. Through motion imagery the Reaper crew observed the insurgents move from one firing position to another and engaged the insurgents when there was no risk to civilians or property.[44] Of course, there are many other examples.

The value of MTI has also been extensively documented. Coalition ground forces have benefited from the collection of 'pattern-of-life' (or Traffic Pattern Analysis) information. This has provided ground forces with improved situational awareness of their areas of operation. As an example, as part of Operation MOSHTARAK in 2010, 1 Royal Welsh commented that MTI information 'allowed them to manoeuvre into areas they knew they could best affect as part of their operational focus'.[45] MTI can also contribute to the counter-IED effort by identifying activity associated with the emplacement of IEDs; if a stretch of road is no longer being used by local nationals, this may indicate the presence of an IED along that stretch of road.[46] At the early stages of the IED cycle, wide area surveillance can also identify the facilitation networks and routes used to transport narcotics out of Afghanistan; as well as identify the movement of vehicles that might be facilitating weapons, IED components and devices into Afghanistan. During November 2010, GMTI information was provided to ISAF ground forces which facilitated the interdiction of suspicious tracks on the ground resulting in the seizure of nearly ten tonnes of narcotics, the identification and destruction of three narcotics laboratories, and the seizure of components and nearly one-tonne of explosives used in the manufacture of IEDs.[47] MTI information can also directly assist a convoy transiting a known area of insurgent activity by identifying tracks that intersect the proposed convoy route that may be indicative of IED emplacement or preparation.[48]

The value of combining different MOTINT assets has also been demonstrated in recent operations; fusion of multiple sources allows analysts to conduct 'target development' or 'network analysis' of a subject area and the observation and recording of motion, can significantly enhance that network analysis. In many cases, the movement between areas of interest can provide an important level of detail that would otherwise be lost by analysis of the individual areas in isolation. In particular, focusing on MOTINT may aid the identification of a key node in a given network. This concept also has application in understanding the human terrain in a given area. MOTINT can assist analysts in their understanding of the relationship between population centres; those that have a greater level of motion between them may indicate amicable relations, perhaps due to tribal affiliation. Conversely, where there is no motion at all, this may indicate a rift or a different tribal affiliation. Similarly, movement between a population centre and a known enemy location may indicate collusion.

Operations in Libya in 2011 again proved the value of MOTINT. The vast open deserts of northern Libya were ideal for MTI platforms. The nature of the campaign, with the conventional forces loyal to Gaddafi on one side and the 'rebels' on the other side, meant that intelligence was essential for situational awareness. Once air operations began in earnest, MOTINT was vital to achieve an effective targeting cycle and the cross-cueing of other platforms. This capability is demonstrated by the cross-cueing of an MQ-1 Predator and an RAF Tornado GR4 by a Sentinel R1 via an E-3D Sentry in the targeting of a Libyan tank. The tactical director of the AWACS described the engagement:

> The target was first found by a Sentinel R1 Airborne Stand Off Radar (ASTOR) aircraft and we passed the target over to a US Air Force MQ-1 Predator unmanned aerial vehicle to identify it…We then talk to the fast jets to make sure the airspace is clear. When everything is ok to hit the target, then it is passed up to CAOC for the Commander to issue his directive.[49]

Without wide-area MTI detecting the movements of Gaddafi's forces, the crews operating the Predator and Tornado would have been consigned to a significantly less-efficient and less-effective visual search. The provision of MOTINT was not just limited to the Sentinel. The Sea King Mk7 ASaC helicopters also contributed GMTI information to operations in Libya. Not only did they contribute MTI data to provide situational awareness in the maritime, littoral and coastal environment, they also directly supported British Army Air Corps' Apache attack helicopters operating from HMS Ocean.[50] MTI was used to identify ingress and egress routes for the Apaches in order to enable them to safely engage targets ashore.

This section has described the evolution of how military forces detect the movements of an adversary. It has demonstrated that technology has consistently provided new capabilities for the provision of MOTINT. From the scourage, to the balloon and then the aircraft, to the invention of radar, the use of radar on AWACS and other MTI platforms, and the ability to collect motion imagery, each capability has delivered an enhancement on its predecessor. These enhancements have provided two main advantages. First, they have provided a capability to detect motion over an increasingly wide area. The scourage was limited to observation at the range of his eyesight and then a pair of binoculars. It was also limited by the vantage point to which he could deploy. MTI platforms, however, such as Sentinel, Joint STARS and SKASaC, provide a capability that can track motion over hundreds of kilometres. The height and reach of air platforms is crucial in delivering this capability. Second, this improved situational awareness can subsequently reduce the 'mass' of other forces required in a given conflict. Situational awareness ensures improved efficiency, economy of effort and concentration of force of other platforms and forces. The cross cueing of an RPAS with a relatively smaller field of view from MTI data has proven itself to be extremely effective. Air MTI ensures that manned and unmanned aircraft are employed more efficiently. For ground forces, the Al-Khafji example from the 1991 Gulf War and even the earlier use of aircraft in the Italo-Turkish war in 1911-12 demonstrates that situational awareness can reduce the requirement for flank and rear protection. The interdiction of specific tracks over a large area in Afghanistan for counter-narcotics and counter-proliferation further demonstrates that MOTINT can facilitate an efficient and effective employment of resources.

The Future of Motion Intelligence

It appears that MOTINT has a bright future indeed. Many systems are currently being developed to provide a MOTINT capability. Improved sensors with greater fidelity and coverage are under development. Moreover, as has been the case throughout history, the platforms that carry a MOTINT sensor are also improving with greater levels of persistence. Thus, sensors that provide larger coverage and platforms with longer persistence are the main enablers for an improved MOTINT capability in the future.

With regards to persistence, there is the potential for RPAS to have an endurance measured in days and weeks instead of minutes and hours.[51] The AeroVironment Global Observer is designed to remain airborne for seven days; Boeing is also producing a system called Phantom Eye which is touted to remain airborne for four days; and Lockheed Martin's High-Altitude Long-Endurance unmanned airship could potentially have an endurance of fifteen days.[52] But the ultimate contribution to improved persistence and coverage is likely to come from space-based radars. The US is currently procuring a Space Radar system to provide a range of capabilities; these include geo-spatial intelligence products, synthetic aperture radar imagery, and, importantly for this article, a Surface Movement Target Indication (SMTI) and Open Ocean Surveillance (OOS) capability.[53] Also, to demonstrate the UK's commitment to such technology, the government launched a £21m investment into space radar technology in November 2011 to part-fund a project by a private company to produce a NovaSar-S satellite for the purposes of synthetic aperture radar imagery as well as MTI.[54]

There continue to be further technological advances in motion imagery and MTI sensors. The contribution of motion imagery to recent operations in Iraq and Afghanistan has resulted in prolific expenditure on this area of Intelligence Surveillance and Reconnaissance (ISR). In both campaigns, motion imagery has provided the 'eyes' that General Pershing so eagerly wanted from his ailing "Jenny" in the Mexican Punitive Expedition in 1916.[55] The Multi-spectral Targeting System (MTS) employed on the MQ-1B Predator (MTS-A) and MQ-9 Reaper (MTS-B), which has a robust suite of infrared sensors, colour/monochrome daylight TV camera, image-intensified TV camera and laser designator, has proved immensely effective.[56] Future wide-area motion imagery capabilities, such as ARGUS-IS by BAE Systems, are billed to be able to image a 7.2km diameter area.[57] ARGUS-IS also has a remarkable capability in that it provides up to sixty-five independently steerable video windows with automatic tracking of a specific vehicle or dismount in any window without commands from the operator.[58]

Technological advances also continue to improve the MTI collection capability. Next generation radars include Northrop Grumman's AN/ZPY-2 sensor on board the Block 40 Global Hawk. This radar has also been suggested for inclusion on the proposed Global Hawk-based Alliance Ground Surveillance (AGS) capability for NATO.[59] A successor to the Littoral Surveillance Radar System (LSRS) is also being developed by Raytheon under the Advanced Airborne Sensor (AAS) project to continue the US Navy's littoral MTI capability on the P-8A aircraft.[60] As an adjunct to the P-8A Multi-mission Maritime Aircraft (MMA) the US is also procuring a Broad Area

Maritime Surveillance (BAMS) Global Hawk variant fitted with an array of sensors including Maritime MTI.[61] Once in service, the system will be able to provide long-range, wide-area and persistent coverage of the maritime environment. The utilisation of radar technology has its limitations when operating in areas of undulating terrain, dense vegetation, and high concentrations of urbanisation. However, technological innovations are also improving the ability to track motion even in areas of dense vegetation. The FOliage penetrating REconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER) is reported to be able to track slow-moving, low-radar-cross section vehicles and dismounts under foliage.[62] Moreover, FORESTER is said to be able to do so over an extremely wide area of 400km squared.[63]

The potential benefits of increasing persistence and coverage are numerous. In a conflict scenario, they provide an improved ability to detect, track and attack targets on the move. Moreover, they would provide a level of forewarning of attack never before dreamed of. Where a country is suspected of developing weapons of mass destruction, MOTINT from satellites could monitor vehicular activity around suspect sites without the need for over flight and basing considerations. Persistent and wide-area coverage could also provide surveillance of long and troublesome borders for law enforcement purposes. MOTINT could also determine which roads are open and useable after a flood in disaster relief and humanitarian crises; it could also determine the level of a refugee crisis by identifying where refugees are currently heading and in what number. MOTINT also has an application in anti-piracy, such as off the coast of Somalia. With enough fidelity, MOTINT could also be used to monitor the after-effects of an earthquake and the potential size of a tsunami, especially in the Pacific. All of this, however, relies on improved persistence and coverage.

Conclusion

This article has articulated the concept of MOTINT and its relation to air power. It has explained what is meant by the term and offered a definition of what this category of intelligence entails. It has also rooted the concept into an historical framework in order to explain how and why modern military forces acquired the capability to detect motion. It has demonstrated the importance of air power in this regard by articulating the significance of height and reach in acquiring MOTINT. In doing so, it has emphasised the value of MOTINT in improving the efficiency, economy of effort and concentration of force in the deployment of other air, naval and land forces. Finally, it has also explained the future developments of MOTINT and how these developments are overwhelmingly reliant on air and space power.

This article argues that technological advances in the ability to detect and track motion have elevated it as a source of intelligence on a par with an image, a signal, and a human agent. It has unique characteristics unlike any of the current intelligence categories. Moreover, the data that a motion imagery or MTI sensor collects requires specific storage, exploitation and dissemination tools. Just as the advent of both imagery and signals intelligence resulted in national agencies capable of organising, collecting, analysing and disseminating IMINT and SIGINT, the importance of MOTINT may require further structural re-organisation in order to process the many different facets of this type of intelligence. In a time of financial uncertainty and budgetary pressures these ponderings about an improved MOTINT capability may prove futile. But, as this article advocates a concept, it is primarily and at least initially being written to provoke discussion and debate. With an improved persistence, coverage and collection capability, it is likely that this type of intelligence will continue to be an important element to the way that modern military forces operate. Given its track record, it is almost inconceivable that a counterinsurgency or conventional military campaign could be conducted without a MOTINT capability. Moreover, the civil applications of such technology are numerous. Understanding the basic concept of MOTINT is an important first step.

Notes

[1] *AP3003: A Brief History of the Royal Air Force*, (London: MOD, 2004), p. 51.
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