

偵察排注入新元素-四軸旋翼機應用(譯文)

Implementing Quadcopter Unmanned Aerial Systems into Reconnaissance Platoons

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提要

- 一、過去美軍為因應反恐戰爭，在傳統無人機 RQ-11 Raven(渡鴉無人偵察機)的支援下，情報蒐集獲得相當大的幫助。但近年來，因傳統無人機成本高，且體積較龐大，及敵人的隱匿的方式改變，導致在使用上漸漸受到阻礙。
- 二、此篇譯文主要針對美軍偵察排使用小型無人機(四軸旋翼機)，執行情報蒐集探討，在它成本較傳統式低外，且使用方式較不受場地、風力及茂密森林限制，這對未來反恐戰爭蒐集情報有相當大的幫助。

關鍵詞：四軸旋翼機(UAS)、情監偵(ISR)、偵察排(Reconnaissance Platoons)、渡鴉式偵察機(Raven)、高級遠程偵察監視系統(LRAS3)

Preface

During the past 18-plus years of conflict in the global war on terrorism, the U.S. military has witnessed the effectiveness of unmanned aerial systems (UASs) in a variety of mission sets. In the beginning, these systems were large and expensive, which initially allocated them to the role of theater-level or battlespace assets. As the years have progressed, miniaturization has allowed these assets to filter down to the squadron and troop levels with systems such as the RQ-11 Raven. As mass production increases and their uses expand, these systems are becoming both smaller and relatively inexpensive to produce. As a result, between 2004 and 2008, the number of UAS deployed globally increased from around 1,000 to 5,000 systems.

前言

在過去 18 年的全球反恐戰爭中，美國軍方證實了無人機系統在各種任務中的效用。最初，這些系統體積龐大又昂貴，初期主要配屬於戰區層級的裝備或是在戰場上使用。隨著時間推移，小型化已使這些裝備可以通過 RQ-11 渡鴉無人偵察機等系統應用到營及連的層級。隨著大量生產和用途的擴大，這些系統變得越來越小，並且相對便宜。因此，從 2004 年到 2008 年，全球部署的 UAS 數量從大約 1,000 架增加到 5,000 架。



This widespread availability has been demonstrated best not by near-peer threats but by non-state actors such as the Islamic State in Iraq and Syria (ISIS). During the battle for Mosul, ISIS flew more than 300 missions in one month, using off-the-shelf drones that cost as little as \$650, mainly quadcopters. Of those missions, about 1/3 were armed strikes, with the remaining missions being intelligence, surveillance and reconnaissance (ISR). This demonstrated both the ready availability of these assets and their effectiveness, especially in urban settings. Despite this, most U.S. troop-sized elements still have only one UAS asset readily available: the RQ-11 Raven system. Instead, each cavalry troop should be operating two quadcopter drone systems per platoon in addition to having the Raven.

這種廣泛的取得性並不是透過國與國之間的衝突來證明，而是透過非國家行為者(non-state actors)，例如伊拉克和敘利亞由叛亂份子所建立的伊斯蘭國(ISIS)來證明。在摩蘇爾(Mosul)戰役中，ISIS 使用市售僅 650 美元成本的無人四軸旋翼機，在一個月內執行超過 300 架次的行動。其中約 1/3 用以實施武裝襲擊或執行情報蒐集，監視和偵察(ISR)等任務。這證明了這些裝備在城鎮環境中的可用性及有效性。儘管如此，多數美軍的連級部隊 (Troop-sized elements) 均只配屬一架 RQ-11 渡鴉式偵察機，而不是每個裝騎連除了配屬 RQ-11 渡鴉式偵察機外，另在裝騎排建制 2 架四旋翼無人機。

Why platoon level?

The use of UAS at platoon level is not an unknown concept in reconnaissance operations. Both Field Manual Interim (FMI) 3-04.155, Army Unmanned Aircraft System Operations, and Field Manual (FM) 3-20.98 have chapters on platoon elements using UAS to conduct operations. The manuals describe how UAS can be assigned to reconnaissance platoons to conduct detailed recon of danger areas, assist with route recons or be used for contact-by-fire. Concerning UAS elements being controlled by the scout platoon, the manual states, “[T]his relationship allows the platoon the most flexibility. The platoon leader can integrate the capabilities of the UAS into the reconnaissance plan in a seamless manner. He [or she] can then respond quickly to mission/target changes.”

為何選定應用在排級

在偵察行動中，排(Platoon)級使用UAS並非是未知的概念。依據臨時野戰手冊(FMI)3-04.155、陸軍無人機系統操作和野戰手冊(FM)3-20.98都有章節關於UAS在排的層級應用上的概念。這些手冊描述如何將UAS分配給偵察排，以對危險區域進行詳細的偵察，協助路線偵查或用於聯絡火力支援。關於由偵察排控制的UAS要領，在手冊中指出：「UAS可以使偵察排發揮最大的靈活性排長可以將UAS的功能整合到偵察計畫中，迅速應對目標或任務的改變。」

Unfortunately in many cavalry troops, the use of UAS, specifically the Raven, isn't seen as a primary sensor system critical to conducting key reconnaissance tasks. This treatment of UAS elements as an ancillary system means that integration of their employment into troop operations is not only ineffectual but often non-existent. Units often don't conduct battle drills with their Ravens, meaning that the crews don't get practice putting their drones into operation quickly during regular operations. For most crews, the only time they bring their Ravens out of the box is either for an inventory or for their 150-day flight for recertification.

不幸的是，多數的裝騎單位在實施偵蒐時並未以 UAS 為主要偵蒐手段。而是將 UAS 元素作為輔助系統進行處理，這表示將其整合到部隊行動中不僅無效，且通常不重要。單位通常不會將渡鴉無人機投入演訓中，這顯示機組人員在平常操作期間，無法練習將無人機快速投入作戰。在大多數 UAS 監偵組中，他們將渡鴉無人機開箱使用的時機不是進行清點，就是執行試飛 150 天的回流訓練。

More problems such as trying to clear restricted operating zones and commanders worrying about losing systems that were designed to be “thrown away” if lost often means that systems simply sit on supply-room shelves. This lack of use means platoons don't get to practice integrating the troop UAS into their reconnaissance plans.

其他的情況，像是在試圖理解作戰限制區域時，連長因擔心無人機執行任務時遭到擊落或遺失，故往往讓這些裝備待在庫房的架子上。導致無人機未確實納入連的偵蒐計畫。



There are also challenges for the units that do use their UAS systems. With only one Raven team per troop-sized unit, the asset is often prioritized for use against named areas of interest or even farther forward of the platoons to look for possible threats. While it is extremely important to get this type of intelligence, it often means that unless a platoon is part of the main effort, it cannot use UAS assets in support of its mission. Even with the Raven team under operational control (OPCON) of a platoon, the platoon's leader runs into the same problem of prioritization if operating in two- or three-truck sections.

這讓用 UAS 系統的單位也面臨挑戰，每個連只有一個渡鴉無人機小組，因此通常優先考慮將該裝備用於指定偵察區甚至分到更遠地方，以偵獲敵軍威脅。儘管獲得這些情報非常重要，但也表示，除非這個排是主力一部，否則它不能使用 UAS 裝備來支援其任務。即使將渡鴉無人機小組受排來作戰管制，但在遇到操作 2 到 3 個區域時，排長也會遇到使用的優先順序的問題。

For example, if all three platoons are running two sections, the troop commander has to divide the use of one UAS element among (potentially) six maneuver elements. This doesn't even include the possibility of dismounted teams. To change this lack of UAS integration, each platoon needs to have two UAS systems organic to its modified table of organization and equipment (MTOE). By having two systems available, the platoon leader can either have each section use one to aid in its reconnaissance tasks, or use one for close-in ISR support while the second moves in advance of the platoon. In either case, the platoon can use the drones in conjunction with other assets, such as the Long-Range Advanced Scout Surveillance System (LRAS3), to create redundancy in its operations.

例如，若三個排各自執行 2 個裝騎組，則連長（可能）必須讓一架 UAS 執行 6 個架次，這甚至不包括使用徒步偵搜的可能性。為了改變這種缺乏 UAS 整合的情況，每個排的修正後編裝須有兩架 UAS 在其建制內。透過使用兩架 UAS，排長可以在每組使用一個 UAS 系統來協助其偵察任務，或是使用第一架無人機提供附近 ISR 支持，第二架則事先移動到排的前方。在這兩種情況下，排可以將無人機與其他裝備（例如高級遠程偵察監視系統（LRAS3））結合使用，使其操作中擁有複式手段。

For example, picture a scenario where the scout platoon is tasked with route reconnaissance and has two UASs as part of its organic composition. The platoon leader designates Drone A to operate one to two kilometers forward of the maneuvering sections, while Drone B operates directly in front of and to the sides to help clear dead space and laterals. Drone A detects a manmade obstacle and begins overwatch. The platoon leader can maneuver either a truck with an LRAS3 or dismounts with Lightweight Laser Designator Rangefinders onto the site. Now, he or she can detach Drone A to continue searching forward of the platoon or have it stay on station for redundancy of sensors, while Drone B is free to conduct other tasks.

例如，假設在戰場景況中，由偵察排負責執行道路搜索任務，且建置內有2架UAS。排長指定A無人機在機動中裝騎組前方一到兩公里飛行，而B無人機則直接在前方及側方幫助搜索側面和死角。A無人機偵查到人工阻絕並開始監視，排長指揮LRAS3或下車到該處使用輕型雷射測距儀。之後，排長就可以離開A無人機繼續向前搜索，或者將A無人機留在陣地增加傳輸偵測功能，創造更多的偵察機會，而B無人機則可以繼續執行其他任務。

If the platoon leader is instructed to bypass and hand over overwatch to a follow-on element, he or she can have a drone maintain recon while the mounted and/or dismounted elements collapse from their positions. Once done, the elements can move out with one drone still scanning forward as the platoon moves and the other drone watching the area until the handover is complete. Then it can be retasked.

不論是在部隊交接時，如果排長被指示繞越且將監視任務移交給後續部隊，後續的人員仍可以維持無人機的監視。完成任務後，其中一架無人機仍可在部隊移動時向前搜索，另一架無人機則監視該區域，直到交接完成。然後無人機就能重新投入其他任務。

The preceding scenario illustrates why independent operation of two UAS drones at platoon level is beneficial. By having these as readily available assets, platoons can involve them during planned training exercises or during “sergeant’s time” in the field. This will increase leadership’s understanding of their function, and it will give the operators increased confidence in the



equipment and their abilities.

前一段說明了為什麼在排級獨立設置兩架 UAS 無人機的好處。透過這些現有的裝備，排可以在計畫訓練中或利用「軍士官團教育」時讓他們參與。這將增強領導者對其無人機的瞭解，並使人員對操作設備及運用能力更有信心。

Yet, while the Raven is an important tool in the ISR arsenal, it is not the best UAS asset for the platoon. Instead, a UAS quadcopter design would be most beneficial.

然而，儘管渡鴉無人機對情監偵而言是重要工具，但它對排級部隊而言，並非建制中最好的無人機裝備。應當配屬無人四軸旋翼機才是最好的。

Why quadcopters?

A quadcopter is a UAS drone that uses four motors to power two pairs of counter-rotating, fixed-pitch blades located at its four corners. The motors do not require complex mechanical control linkages to operate because variations in motor speed allow it to maneuver. This simplifies aircraft design and operation. Research has shown that the “most versatile and mechanically easy to construct autonomous aerial vehicle is a quadrotor helicopter.” This ease of construction and use is why they have been become highly popular in commercial markets. A simple search on a retail store’s Website showed more than 30 different types of quadcopters available with prices ranging from \$30 to \$3,000.

為何選定四軸旋翼機

四軸旋翼機是 UAS 系統無人機其中一種，使用 4 個電動馬達，其 2 對反向旋轉的固定螺旋槳位於 4 個角，提供葉片動力。電動馬達不需要複雜機械控制的聯動裝置即可操作，透過轉速的變化使其可以機動。簡化了多軸飛行器的設計和操作。研究說明：「四軸旋翼機是功能最齊全、機械構造最簡單的自動駕駛飛行器。」這種簡易的構造和使用的特點，使得它們在商業市場上廣受歡迎，搜尋網路上零售商店樣式，會出現 30 多種不同類型 30 到 3,000 美元不等價格的四軸旋翼機。

The most obvious advantage of the quadcopter design is its increased agility over conventional planes. Quadcopters are so agile that the Drone Racing League flies quadcopters over the seats and through the concourses

of the Miami Dolphins stadium at speeds approaching 80 mph. This agility means that a quadcopter UAS could fly in environments where a Raven could not, such as within heavily forested areas or vertically dense cities. Where a Raven can only fly over the woods to look for enemy locations, hoping to see them through the foliage, a quadcopter can fly under the canopy to find hostile positions. They can also be flown inside buildings and compounds to help quickly see if there are potential booby traps or ambush sites before execution of a breach.

四軸旋翼機的設計最明顯的優勢是，其敏捷性比傳統無人機還要好。四軸旋翼機是如此敏捷，以至於無人機賽聯盟四軸旋翼機以接近 80 英里 (mph) 的速度，在邁阿密海海豚體育場的大廳內和座位上方飛行。這種敏捷性意味著四軸旋翼機可以在渡鴉無人機無法飛行的環境中飛行，例如「茂密的森林地區或垂直密集的城市」。渡鴉無人機只能飛越樹林上方，從樹林縫隙間尋找敵軍動態，而四軸旋翼機則可以在樹冠下飛行尋找敵軍。它們也可以在建築物和複合式建築內飛行，以幫助在執行突破前快速查看，是否存在潛在的誘殺裝置或伏擊設施。

The quadcopter's ability to hover just feet off the ground while providing real-time imagery day or night would be invaluable to reconnaissance platoons. During route reconnaissance in Afghanistan, scout-platoon dismounts have to clear culverts for the presence of improvised explosive devices before trucks can move forward. While LRAS3s¹ or Ravens can search the area, they can't look low enough to actually see inside the culverts. Therefore dismounts must still try to safely get eyes on. However, a quadcopter that can hover just outside the culvert's opening can get the same intelligence without having to involve a dismount. This keeps Soldiers safe. This same capability can be used to inspect other structures such as bridges, too.

四軸旋翼機具有滯空功能，且能同時在白天或夜晚提供即時影像，這對於偵察排來說是非常有用的。例如在阿富汗進行道路偵察任務中，車隊前進之前，偵察兵必須下車清理涵洞，尋找是否存在簡易爆炸裝置。儘管遠程高級監視系統或渡鴉無人機可以搜索該區域，但無法降低到可偵察涵洞內部實際情況。因此，仍須以人員徒步現偵執行。但四軸旋翼機可以在涵洞外滯空偵察，獲得相

¹ LRAS3s 遠程高級監視系統，美商雷神公司製造。



同的情報，而不須偵察兵去進行拆卸，且可以確保士兵安全。亦可以用於檢查其他橋樑結構等狀況。

This kind of use of quadcopters is already employed in the civilian sector. The hover and low-level flight ability of these drones also means operators can train themselves and others on basic operations inside large open spaces such as drill floors.

在民間已經廣泛運用這種四軸旋翼機。如在大型露天場所，操作員可以訓練自己和其他人，操作無人機懸停及低空飛行的功能。

Advantages over Raven

A quadcopter has many advantages over the Raven because of its vertical take-off and landing capabilities, especially when it comes to launch and recovery. The difficulty of launching the Raven in zero wind conditions is increased and requires the crew to throw the system from atop a vehicle or building. The system also requires a clear area to launch safely. Landing must also be made in a clear area, and the system “lands” by stalling about 10 feet off the ground before falling and breaking apart (designed to come apart with easy reassembly).

四軸旋翼機比渡鴉無人機好的優點

四軸旋翼機因為具有垂直起降功能，具有較渡鴉無人機多的優勢，尤其是在發射和回收方面。在無風的條件下會增加發射渡鴉無人機難度，唯有讓乘員將渡鴉無人機從車輛或建築物上方拋下。且該系統還需要一個安全的場域，在降落之前離地面約 10 英尺開始「降速」才可以安全著陸（避免解體）。

Instead, a quadcopter can take off easily in calm or windy conditions, and it can pierce the densest forest canopy as long as there is a small hole. A quadcopter drone can not only take off from the operator's hand, but it can land by hovering just a few feet away, allowing the operator to grab it safely from the air. This means that a Bradley crew could launch and recover its UAS just by cracking the top hatch enough to set the quadcopter outside the Bradley.

取而代之的是，四軸旋翼機可以在平靜或有風的條件下輕鬆起飛，並且只要有一個小洞，就可以穿梭在最茂密的林冠層。四軸旋翼機不僅可以從操作員的手上起飛，還可以滯空於幾英尺高，使操作員可以安全地從空中抓起它。M2 布萊德雷步

兵戰鬥車(Bradley)乘員只需打開外部的頂門蓋，就能夠在車上發射和回收。

Regarding the ISR mission, quadcopters have an advantage as well. Both traditional and quadcopter systems have day and night camera operations, but systems like the Raven must continuously circle the target. A quadcopter can instead hover just behind cover and rotate in place to change its view. Many systems come naturally equipped or can have payloads of gimbaled cameras attached to the drone to increase its surveillance ability. The Instant-Eye family of quadcopters not only can have gimbaled cameras attached, but they can also mount white or infrared floodlights to illuminate targets. They can also mount a 10x zoom video camera.

關於情監偵任務，四軸旋翼機也有優勢。傳統及四軸旋翼機系統都具有晝夜攝影機操作，但是像渡鴉無人機這樣的系統必須對目標持續圍繞監視，而四軸旋翼機可在適當的位置掩護後並以更改其視野。許多系統都具有基本配備，但也可以有效裝載數個多角度(gimbaled)攝影機以提高其監視能力。Instant-Eye(公司名：新視角)系列四軸旋翼機，不僅可以安裝多視角攝影機，而且還可以加裝 10 倍變焦鏡頭或閃光或紅外線裝置來照亮目標。

This ability to attach mission-specific payloads and the increased agility of these platforms are a few of the reasons why the Navy and Marine Corps Small Tactical Unmanned Aircraft Systems Office (PMA-263) ordered 800 InstantEye systems in February 2018. The purpose of the 800 systems is to include them organically into infantry squads to enable ready-to-use UAS capabilities at squad level. The system ordered is the Mk-2 GEN3- A0, which is considered “expendable” since it does not store digital data onboard. It requires only a single operator; can go from stowed to operational in 30 seconds; has a two-kilometers range; and weighs only 1.2 pounds. This same system was also tested by the troopers of 3rd Squadron, 71st Cavalry Regiment, overseas during their deployment for Operation Inherent Resolve.

美國海軍和海軍陸戰隊的小型戰術無人機系統辦公室(PMA-263)，因為多軸旋翼機能夠具備特定任務的有效裝載能力，以及平台較高靈活性，於 2018 年 2 月訂購 800 套 Instant-Eye 系統，目的將應用於步兵班中，雖然訂購的機型是 Mk-2 GEN3- A0(四軸無人機種)，由於無法儲存數位資料，被認為「可有可無」。但因只需 1 個操作手、僅重 1.2 磅，即可在 30 秒內從收起狀態轉為工作狀態，巡航範圍可達 2 公里。同樣的機型也部署在海外的第 71 中隊騎兵團第 3 中隊突



擊步兵進行測試。

Figure 1 : SPC Michael Kobart (left) and SGT David Vidrine, both with Troop A, 3rd Squadron, 71st Cavalry Regiment, 1st Brigade Combat Team, 10th Mountain Division (Light), inspect the Gen4 Instant-Eye during training in Baghdad, Iraq. The Instant-Eye gives Soldiers the ability to see what is around them without endangering personnel.

(U.S. Army photo by SGT Cheryl Cox)



圖 1、下士邁克爾·科巴特（左）和中士大衛·維德林（右）與第 10 師一旅戰鬥隊 71 騎兵團第二中隊 A 連一起在伊拉克巴格達訓練，檢查 Gen4 InstantEye。

InstantEye 無人機，使士兵能夠看到周圍景象，而且不會危及人員安全。

（資料來源：美國陸軍圖片由中士 Cheryl Cox 拍攝）

While there are significant benefits to the quadcopter design, there are disadvantages. The Raven battery gives it a flight time between 60 to 90 minutes on a single charge. Currently systems like the Instant-Eye Mk-2 GEN3-A0 only have enough battery capacity for about 30 minutes. While industry leaders are currently looking at hybrid power or fuel cells to solve this issue, it may be awhile before they match comparable flight times to traditional UAS like the Raven.

雖然四軸旋翼機設計有很多優點，但也有缺點。渡鴉無人機電池一次充電可提供 60 至 90 分鐘的飛行時間。以目前 Instant-Eye Mk-2 GEN3-A0 之類的多軸旋翼機，電池僅具有約 30 分鐘的容量。研發廠商目前正在尋找混合動力或燃料電池來解決這個問題，可能還需要一段時間才能將其飛行時間與傳統的 UAS（如渡鴉無人機）相媲美。

Probably a more significant issue is that of electronic warfare and/or cyber threats. In 2009, newspapers across the country had headlines describing insurgents grabbing Predator drone feeds, using \$26 software to access unsecured communications links. Later in 2011, the drone fleet was affected by a virus found on classified and unclassified computers at Creech Air Force Base, NV. An increased awareness of these threats led to the Department of the Army ordering Soldiers to cease all use of the Dajiang Innovation family of quadcopter drones in May 2017, citing “increased awareness of cyber vulnerabilities” as the reason.

然而更重要的問題是電子戰和(或)網絡威脅，2009 年全國各地的報紙都刊登了頭條新聞，描述叛亂分子使用 26 美元的軟體來獲取非法的通信鏈結，從而奪取了 Predator 無人機的資訊。之後在 2011 年，該無人機機隊在內華達州的 Creech 空軍基地，受到了加密及未加密的電腦病毒影響。在這些威脅的情況增強下，導致美國陸軍於 2017 年 5 月以「要增強對網路漏洞的防範」為理由，下令部隊停止使用大疆創新(Dajiang Innovation)系列四軸無人機。

Many drones immediately return to a designated point if they lose their control signal. This means that enemy actors could use specialized jammers to create an operational area where our drones cannot operate, not dissimilar to the U.S. military's use of phone jammers overseas. This kind of ability is already being seen in operational theaters. On April 10, 2018, the New York Post reported that Russia was jamming the Global Positioning System (GPS) components of U.S. drones in Syria. Another similar problem is that drone operations rely heavily on GPS data to know where the ground-control station, the enemy and the UAS are located. Enemy actors could “spoof” the GPS information being received, resulting in the system going to either false-target locations or areas where the enemy could capture the asset. A possible answer would be the use of the already available simple-key loader devices to encrypt drone GPS systems.

許多無人機在失去控制信號後會立即返回指定點。這表示敵軍可以使用專門干擾的裝置，製造出讓無人機無法操作的作戰區域，這與美國軍方在海外使用電話干擾器類似。這種能力已經在戰場上可以看到。2018 年 4 月 10 日《紐約郵報》報導說，另一個類似狀況是俄羅斯干擾美軍無人機在敘利亞的全球定



位系統(GPS)，無人機操作嚴重依賴 GPS 數據來獲得地面控制站及敵人和 UAS 的相對位置。敵軍可能「操控」接收到的 GPS 信息，從而導致系統前往錯誤的目標位置或敵人可能捕獲裝備的區域。解決的方法可能是使用現有簡單介面的加密器設備加密無人機 GPS 系統。

Regardless, as technology advances, both the Department of Defense and manufacturers will need to ensure that their drones can face these threats to operate on future battlefields.

無論如何，隨著技術的進步，國防部和製造商都需確保其無人機在未來的戰場上作戰能夠面對這些威脅。

How to implement

The Army should designate a mix of Active Component and National Guard squadrons as testing units. These should be a mix of light (such as airborne), medium (Stryker and infantry brigade combat teams) and heavy (armored-cavalry regiments and armored brigade combat teams) squadrons to encompass all aspects of cavalry operations. These units should have two or three trained Soldiers per platoon who receive necessary training in flight and systems management, overseen by a squadron master trainer.

該如何驗證

陸軍應指定一個由現役部隊和國民兵組成的裝騎營作為驗證單位。由輕型（例如空降兵），中型（史崔克和步兵旅戰鬥隊）和重型（裝甲騎兵團和裝甲旅戰鬥隊）裝騎營的組合，以涵蓋裝騎部隊在各方面的作戰任務。這些單位每個排必須在裝騎營師資監督下接受飛行和系統管理方面的培訓2至3名士官兵。

The master trainer would be responsible for both the quadcopters and assets like the Raven. Each platoon would receive two quadcopter UAS systems and start receiving training from the troop trainers. For the MTOE, the drones should be assigned to the section leaders' crews. This would ensure that in either the two or three-truck section, the UAS would be in the maneuver elements to maximize reconnaissance assets forward.

在編裝中，應該將無人機分配給各組組長，每個排編配2套四軸無人機系統，由師資負責四軸旋翼機和Raven等裝備培訓。並提供2至3部車輛，以確保在任務執行中UAS都能處便於機動，以提高偵察裝備的長途運輸能力。

The troop could then plan force-on-force reconnaissance missions, using both platoons to maintain its UAS proficiency and to start learning how to avoid UAS. With the rise of enemies such as ISIS now using UAS against us, it is imperative that reconnaissance platoons understand how best to counter these operational threats.

然後，部隊可以計劃使用武力偵察任務時，讓這兩個排保持對UAS的熟練程度，並開始學習如何避開其他的UAS系統。隨著ISIS之類的敵人崛起，現在也使用UAS對付部隊，偵察排必須了解如何應對這些作戰威脅。

The troop should also integrate drone reconnaissance into these missions, using the Raven system to support one of the platoons with its task, or to act as a third party and try to find any opposing-force (OPFOR) maneuvering elements within its designated reconnaissance area. This would give troop and platoon commanders the experience of using the troop's Raven asset to aid in reconnaissance plans. Proficiency should reach a level where the troop can plan a reconnaissance mission with the UAS available, which is habitually integrated in the plan to ensure redundancy and continuous reconnaissance.

部隊應將無人機偵察整合到這些任務中，使用渡鴉無人機來支持其中一個排的任務，或者充當第三方，並嘗試在所指定的偵察區域內，偵蒐敵軍部隊動向。這將使連、排長在運用渡鴉無人機作為偵蒐輔助手段，獲得更豐富的實戰經驗。此項訓練熟練程度，影響部隊運用UAS於偵察任務的水準，並將UAS運用整合到計劃中，以確保偵察不中斷。

While this process is occurring, squadrons would be taking lessons-learned from across the various line units to create a unit standard operating procedure (SOP) for employment of the Raven and quadcopters² UAS. The squadron should also start practicing integration of the brigade's organic UAS asset: the RQ-7 Shadow³ aerial-reconnaissance platoon.

在此過程進行期間，裝騎營將從各個演練中汲取經驗，以建立使用渡鴉無人機和幻影四軸旋翼機的標準操作程序（SOP）。該裝騎營還應開始練習整合旅的UAS裝備：暗影無人機空中偵察排。

² Quadcopters 幻影四軸旋翼機，中國大陸大疆公司

³ RQ-7 Shadow：暗影無人機，



The increase of UAS assets in the area of operations will require deconflicting airspace with conventional fixed-and rotary-wing aircraft. This will be a key task for the squadron tactical-operations center.

因應數量漸多無人機列裝，關鍵在需透過中隊戰術作戰中心，協調定翼機和旋翼機在空域的管制，以避免發生衝突。

The Marines experienced this issue during the Sea Dragon 2025 Integrated Training Exercise. Solutions they found were the use of brevity codes to automatically bring UAS down to either a restricted altitude and/or grounding flights if low-level close-air-support was needed, and developing a five-line radio call (to provide pertinent information for air assets) to submit to higher to get company-level UAS to fly higher than 1,000 feet above ground level.

海軍陸戰隊在「海龍2025」綜合訓練演習中發現，可透過使用簡短代碼控制解決空域管制問題。如果需要低空空密接支援，則可以透過代碼自動將UAS降落到受限高度或停飛於地面，此外也為空中設備開發了五個無線電頻道，以提供設備聯繫要求，讓中隊級UAS能飛越地面1,000英尺以上。

The culminating event for the squadron would be to go to a training center to conduct a force-on-force operation with UAS integration from squadron to platoon level. This could either be done as part of a brigade rotation or as a stand-alone event. During this event, a Shadow aerial-reconnaissance platoon should be OPCON to the squadron. Once all the squadrons finish their rotations, an evaluation of lessons-learned from both the squadrons and the OPFOR should be conducted. The Army could then take this information and create a cavalry-squadron UAS SOP and best practices for all cavalry units to use going forward.

最後該中隊將會到訓練中心，進行從中隊到排級整合UAS的作戰訓練。這既可以作為大隊輪訓的一部分，亦可單獨實施完成。在此訓練中，Shadow空中偵察排應該受裝騎營作戰管制。一旦所有裝騎營結束其輪訓，就對該裝騎營和對手所汲取的經驗訓練實施檢討。然後，陸軍就可以獲取這些相關資料，並建立一個裝騎營無人機訓練與操作的標準作業程序和最佳做法，以供所有裝騎部隊使用。

The final key to the implementation process is getting leadership the resources to best access the incoming UAS feeds. Currently, most troop and platoon leaders do not have the capability to watch drone feeds from any UAS asset inside their vehicles while moving. A possible solution could be the installation of viewing systems such as the One-System Remote Video Terminal ⁴(OSRVT) into vehicles. This laptop-like system has an adaptor kit, so it can operate from almost every Army vehicle.

實施過程的最後關鍵是讓指揮者懂得運用即將來臨的UAS的系統。目前，連、排長大多在部隊移動時，無法監視任何UAS裝備反饋的訊息。一種可能的解決方案，是在車輛中安裝類似遠程影像端監視系統，可相容於筆記型電腦的系統中件，可在所有陸軍車輛上使用。

In 2015, a Stryker brigade used the OSRVT system, installing it from brigade to company level during a rotation at the National Training Center, Fort Irwin, CA. If these systems are able to view feeds from quadcopter UAS, then installing them into the vehicles of the section leader, platoon sergeant and platoon leader would enable the leaders to view footage from UAS systems organic at all levels of a brigade. These systems should also be installed in the vehicles of the troop commander, first sergeant, executive officer and the TOC to enable the same capability. Even if the platoons do not get their own UAS, the troop and platoon leadership should still be equipped with drone-viewing systems to better integrate the UAS assets they already have.

史崔克旅於2015年進訓加州Fort Irwin國家培訓中心實施輪訓時，由旅到連級部隊車輛，均安裝遠程影像端監視系統。如果這些系統能夠查看來自四軸旋翼機所回傳的資訊，則將其傳遞到領導幹部的車輛中，可以讓指揮官查看來自旅以及及各級部隊的UAS回傳影像。這些系統還應該安裝在裝騎連長，士官長，副連長和機動指揮所中，以實現相同的功能。即使排沒有他們自己的UAS，連、排長也應該配備無人機終端系統，以更好地整合他們現有的UAS裝備。

⁴ One-System Remote Video Terminal (OSRVT) 遠程影像端監視系統



Other alternatives could include using radio systems such as the Harris Corps' RF-335, which is designed to support full-motion video from nearby drones, a capability that could even be used by dismount team leaders away from vehicle-based systems.

其他替代方案可能包括使用無線電系統，例如哈里斯公司的RF-335，該系統主要功能甚至可由徒步偵搜的伍長所使用，以支援附近無人機的全動態影像傳輸。

Conclusion

While the “standard-issue cavalry scout” will always be the Army's primary reconnaissance sensor, that scout will need other systems to help increase effectiveness, namely drones. The use of drones on the battlefield will grow exponentially during the next 10 years as technology advances. As an indicator of this, U.S. Special Operations Command requested more than \$74 million for the 2019 fiscal year (FY) to procure a variety of UAS, including \$10 million for 527 nano-sized⁵ vertical take-off and landing UASs.

結論

雖然「標準裝騎偵蒐部隊」為陸軍的主要偵察部隊，但該部隊將需要運用無人機系統來協助以提高偵搜能量。隨著技術的進步，在未來十年中，無人機在戰場上的使用將成倍數增長。為了說明這一點，美國特種作戰司令部要求在2019年採購超過7,400萬美元的各種無人機系統，其中包括1,000萬美元用於購買527架微型垂直起降的無人機。

The Army's “cargo-pocket” ISR program is already looking at deploying pocket-sized aerial-surveillance devices to the squad level. In the future, these will be essential to small-team operations such as a dismounted listening posts/observation posts, but at the platoon level, it will still be essential to have an organic UAS asset that can provide real-time intelligence on the move. As stated in the Reconnaissance and Scout Platoon manual, “UASs provide additional information needed by the platoon leader to determine which routes and cross-country terrain best accommodate reconnaissance operations.”

⁵ 27 nano-sized(品名)

陸軍的「裝載偵測」監偵專案，已經在考慮將小型偵察航空監視設備部署到班。將來這些設備對於小部隊作戰更顯得重要，例如徒步的聽音哨(觀測所)。

- 但是在排級，擁有UAS裝備仍然不可少，該裝備可以提供移動中的即時情報。
- 如《偵察和偵察兵排》手冊所述：「 UAS提供排長最佳執行偵察路線及地形。」

While there are currently multiple UAS already available, none of these can match the agility and employability of the quadcopter UAS. They are more agile, simple to deploy and can operate even in dense vegetation and complicated urban terrain. Quadcopters also have the capability to land on terrain or buildings, and they can be used as a remote video sensor, something no Raven could even attempt. Simply put, the addition of quadcopter UAS into the platoons would only increase their ISR capabilities and overall lethality.

雖然目前有多種無人機可用，但是這些都無法與四軸旋翼機的敏捷性和可使用性相匹配。四軸旋翼機具備敏捷、易於部署的特性，甚至可以在茂密的植被和複雜的城市地形中使用，還具有降落在各地形或建築物上的能力，亦可以用來作遠端影像感測器，這甚至是渡鴉無人機都無法做到的。若能將四旋翼無人機系統應用於排級單位中，能增加其情監偵能力和整體殺傷力。

參考資料

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