Aerial Reconnaissance

Tactical Airborne Reconnaissance Pod System (TARPS)
Advanced Tactical Air Reconnaissance System (ATARS)
Shared Reconnaissance Pod (SHARP)

GOUGE FOR USE BY VIRTUAL UNITED STATES NAVY

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Prepared By CPT Kyle Cowden, CAG

CVW-11

INTRODUCTION

It is not the purpose of this document to provide a comprehensive treatise but rather an overview of the history, uses and tactics associated with aerial reconnaissance. It is this author's intention to provide a realistic treatment of the subject while providing a practical application within the realities of the Flight Simulator environment.

1- History

1.1 Throughout the history of war there have been few constants. One constant has been to "take the high ground". Early this was literal for building a defensible position. Later this became important as a means of situational awareness. The situational awareness problem became a priority unto itself and reconnaissance became a highly specialized discipline. The techniques, equipment and means of communicating the tactical information has changed but the objective is the same, "Get where you can see the enemy, figure out what he's doing and then TELL SOMEBODY!"

1.2 Since the Napoleonic Wars, that "…get to where you can see the enemy…" has involved aviation. In the U.S. Civil War, balloons were used to elevate reconnaissance and artillery observers above the fray so they could assess the battlefield and tell the artillery where to direct their fire. The balloons were tethered and had a telegraph wire running down it to a CP on the ground. The observer, looking through a spyglass would telegraph his information to the CP including positions, movements and BDA (Battle Damage Assessments).

1.3 At the start of WW1 the airplane was still in its infancy. As wars do, this was the impetus for technological advancement and soon huge strides in aircraft development became commonplace. But before the synchronized guns and 4-stroke motors the plane was an intelligence-gathering tool as was the kite balloon. The balloon techniques and equipment had changed little since the Civil War. However their effect was devastating and "Balloon Busting" became a huge priority. First with towed grappling hooks, then with rifles and finally mounted machine guns. Interestingly, the first military use of parachutes was by balloon observers.

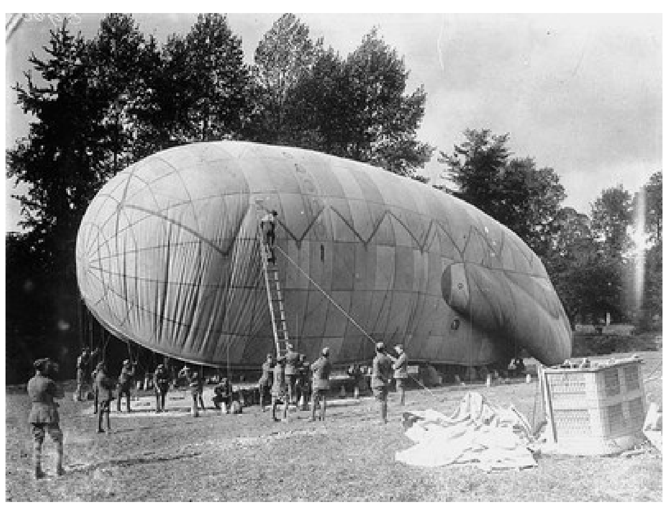


Figure 1-1: WW1 Kite Balloon being readied.

1.4 The mobility and versatility of the airplane made it an increasingly important asset to aerial reconnaissance. The plane could fly to a specific area of interest, make observations and report back in the time it took to ready a kite balloon. Cameras made them invaluable and again they became high value targets. The allies used a Graflex camera, which used hand coated glass plates that took remarkably high definition and well contrasted pictures. The plane was usually a two place outfit wherein a photographer sat in back and simply hung over the side and shot the target area.

Figure 1-2: The Graflex Camera and an aerial reconnaissance run.

Figure 1-3: A mapping photo taken with a Graflex

1.5 In WWII The fighter plane and bombers were equipped with gun cameras and sight cameras to record BDAs to other aircraft and targets. The need for immediate "real-time" intelligence called for some fighters to have their guns temporarily removed, cameras mounted and to make low-level high-speed passes over a target. Some planes were well suited for this role and dedicated variants evolved. The P-38L was just such a variant. The nose was emptied of all guns and cannons and optically flat panes were installed and variable camera configurations could be then installed for particular reconnaissance missions. The pilot often remotely operated the aircraft's cameras, some had a piggyback configuration where the back-seater was a RIO of sorts; he navigated, operated the radar and the cameras. There were rare cases wherein a photographer would curl up in the nose like a hibernating rabbit and manually target photographs.

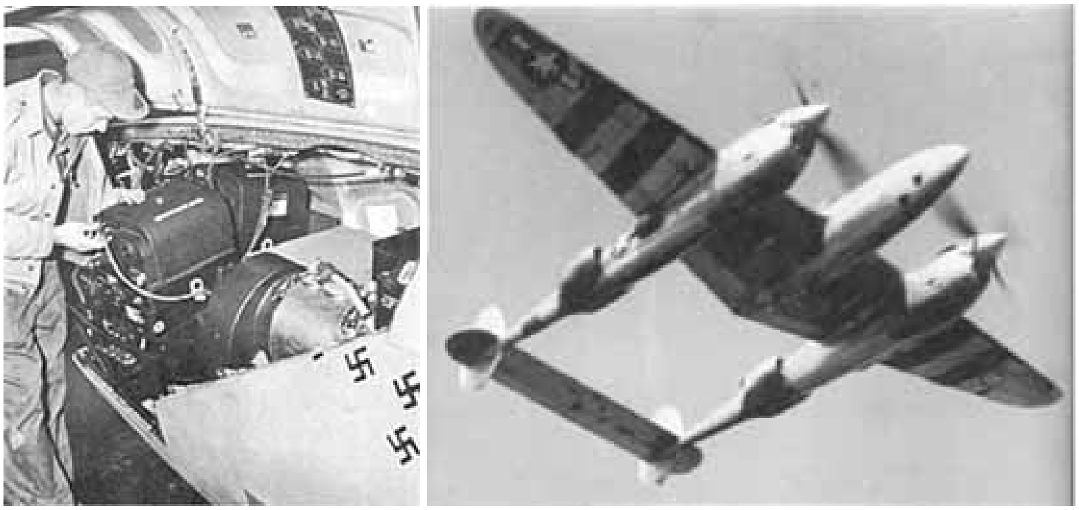


Figure 1-4: Photo-Recon variant camera compartment and flying.

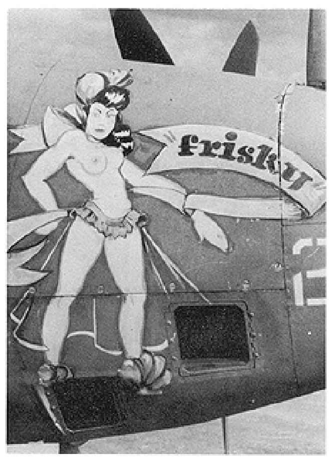


Figure 1-5: Close up of nose windows; "friskit" refers to a masking medium in graphics; thus the pun.

1.6 Dedicated photoreconnaissance airframes became increasingly useful and in Korea the F2H-2P Banshee variant became popular. It could take highly detailed photographs at altitude or very low levels. This author has seen some photos wherein the lateral shots were looking **across** the flight line to aircraft parked on either side! Again the most common application involved a pilot gazing into a panoramic scope and taking photos from the cockpit.

Figure 1-6: Cockpit of the F2H-2P Photo Banshee (www.uscockpits.com)

Figure 1-6: The photo banshee and cameras at the National Museum of Naval Aviation

1.7 Photo variants remained until recently modern times. But as fiscal austerity, adaptability and ever changing technology became the driving forces; dedicated reconnaissance airframes became a practical impossibility. So several attempts at removable and highly effective photographic reconnaissance systems were made. Modular camera units and external mounts became the trend but unfortunately they were usually limited in use and not quickly serviceable.

1.8 The first truly effective module was the Tactical Aerial Reconnaissance Pod System or "TARPS". This system was developed specifically for the Grumman F-14 Tomcat in the early 1980s. The combination of the modular and variable system and the incredibly agile Tomcat was a marriage made in heaven. As the Navy and other services moved toward airframe integration and interchangeability the TARPS was adapted for use on other variants. Avionics interface problems and conformity with airframes presented myriad problems so a search for an interchangeable system became paramount. This search yielded the Advanced Tactical Aerial Reconnaissance System or "ATARS" and most recently the Shared Aerial Reconnaissance Pod or "SHARP".

1.9 TARPS will be a long time in leaving but the decommissioning of the Tomcat has hastened its demise. Availability of the other systems has ensured our intelligence gathering superiority for many years to come and cost-effective compatibility with our ever-changing inventory of aircraft. The next sections will deal specifically with each of the three systems.

2 - Tactical Airborne Reconnaissance Pod System (TARPS)

2.1 The capabilities of the TARPS are very effective with some key limitations. It is capable of high-resolution overhead photographs, low level high-speed pictures and infrared data synchronization. Its most notable limitation is that it is only effective in fair-weather and within certain lighting limitations. Interfacing with LANTIRN, FLIR and TVO systems has remedied this to a large degree allowing night and low visibility use, but weather is still a largely limiting factor.

2.2 The configuration and anatomy of the TARPS leads to an adaptability that has allowed it to live as long as it has. The front compartment has a frame camera that can look forward and straight down. This is usually used in medium to high altitude applications. The second compartment holds the low-level panoramic camera, which takes constant, highly detailed photographs as the F-14 flies *through* the target area and the third compartment holds the infrared sensor array. The last compartment holds the avionics interface equipment.

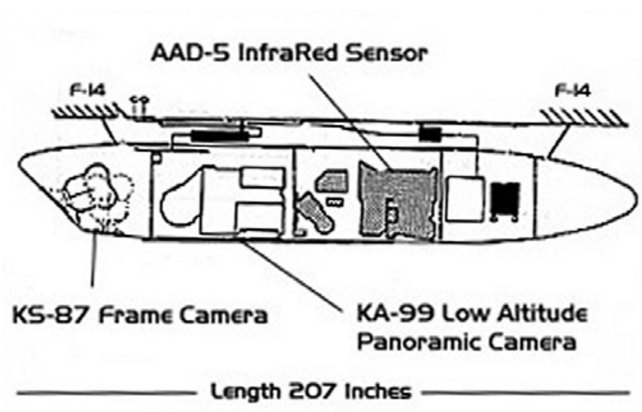


Figure 2-1: Layout of typical TARPS arrangement.

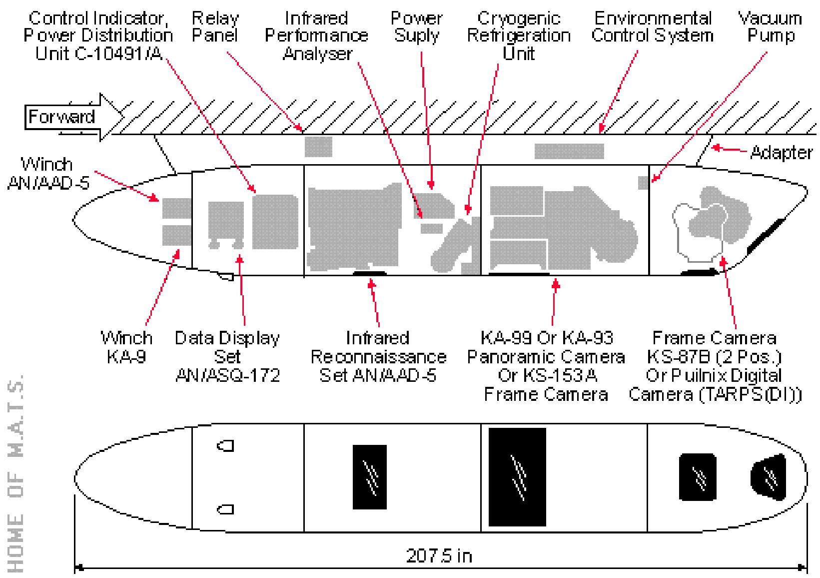


Figure 2-2: TARPS detail with window positions

2.3 When the pilot or operator activates the TARPS several sensors start running simultaneously and data is recorded. Originally this was on film and graphs but advances in avionics and electronics allow all the data to be recorded digitally. First on tape and now in compressed format on hard disks. The coverage of a typical TARPS run is fore, aft and lateral.

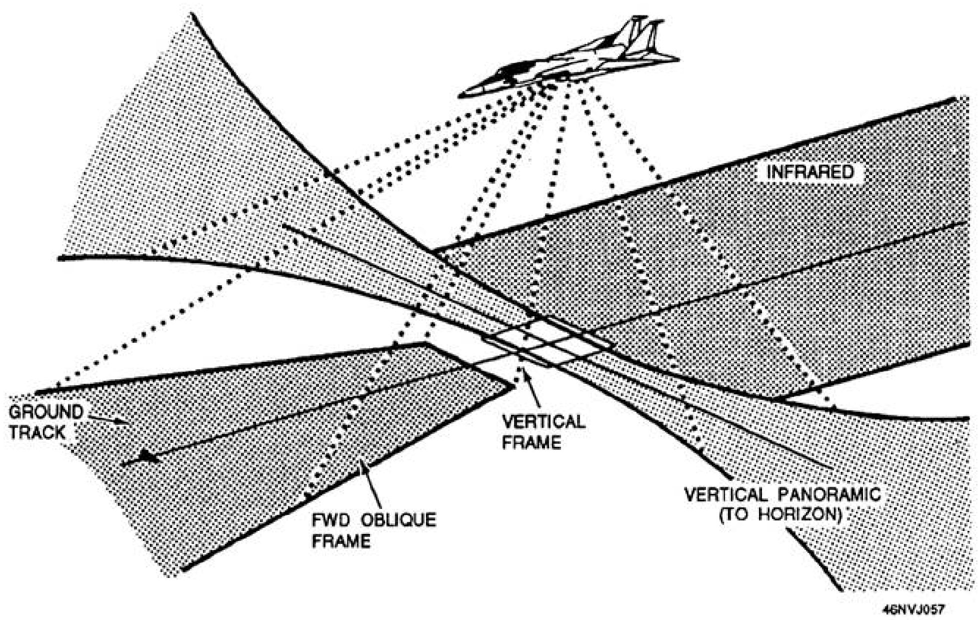


Figure 2-3: TARPS coverage on a typical run.

2.4 The TARPS is mounted (on the Tomcat) at hard point #5 just right of centerline.

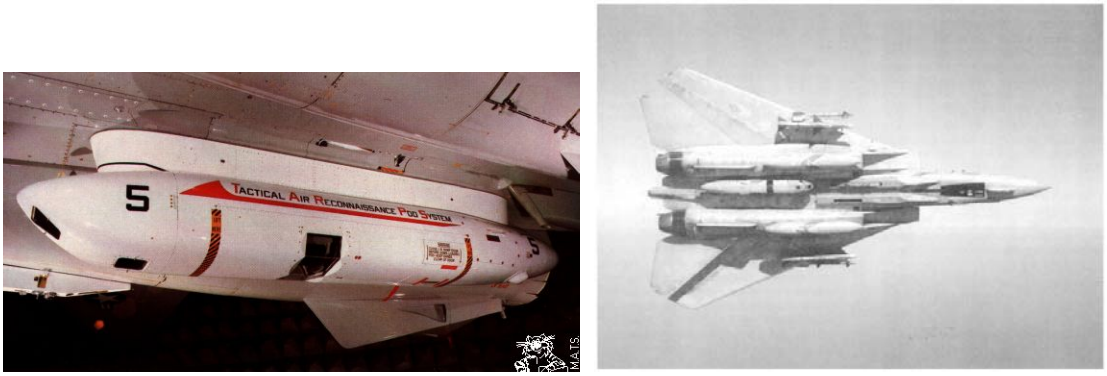


Figure 2-4: Close-up of TARPS and F-14 flying with TARPS.

2.5 TARPS passes are mostly made at altitudes approximating 30,000 feet. Advances in digital imaging and optics allow for highly detailed photos from miles above the ground. However there are times when the 2-D planetary pictures are inadequate or the area is too "hot" to fly over in "plain sight". Thus there are times when "skimming the weeds" or "trimming the hedge" is necessary. The TARPS is well suited for both applications.

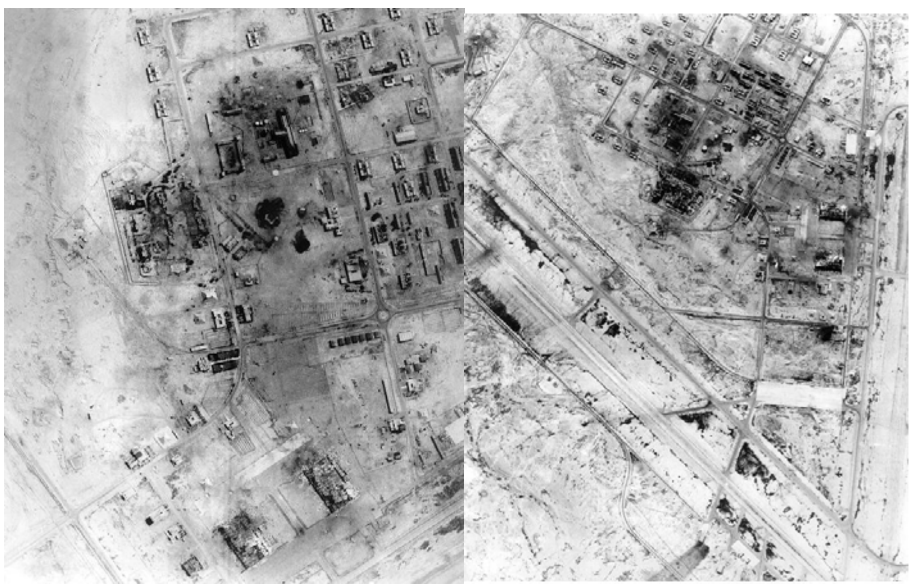


Figure 2-5: BDA TARPS pass in Iraq from 32,000 ft.

3 – Advanced Tactical Air Reconnaissance System (ATARS)

3.1 Originally proposed and designed for Air Force F-16s it was intended to be a sensing suite enclosed in a detachable pod similar to the TARPS. Cost overruns, developmental delays and gross mismanagement nearly doomed the system. It was picked up by the Navy and Marines and became a modular system that can be installed in standard airframes in a short period. In the F/A-18 for example, the lower tray behind the radar is dropped, the cannon system removed and the ATARS is mounted. Then the bottom compartment panel is replaced with one with photo panes in it.

3.2 The Advanced Tactical Air Reconnaissance System Follow On (ATARS FO) is an airborne tactical reconnaissance system composed of an F/A-18D aircraft, electro-optical/infrared and radar sensor suites, a digital recording device, and a ground component called JSIPS (Joint Service Imagery Processing System). The system will provide imagery via data-link to any Joint or Coalition unit that has a JSIPS ground station.

3.3 The internal nose mounted sensor suite called the ATARS pallet contains several key components. The Low Altitude Electro Optical (LAEO) sensor provides imagery from direct over flight of targets. The Medium Altitude Electro Optical (MAEO) sensor operates from 3,000 to 25,000 feet and covers areas in a 22^0 swath at ranges of up to 5 nautical miles. The primary use of these two sensors would be post strike bomb damage assessment (BDA) missions. The Infrared Line Scanner (IRLS) operates in two modes: wide and narrow. Both modes operate from 200 to 25,000 feet and require over flight of the imaged area. The IRLS will allow detection of tactical targets such as recently operated vehicles or generators through detection of their heat signature. Imagery obtained through the LAEO, MAEO, and IRLS systems can be data linked to a ground station if the aircraft is carrying an external data link pod.

3.4 The Infrared/Electro-Optical Long Range Oblique Photography System (IR/EO-LOROPS) is a pod-mounted system that will provide day and night long-range imaging capability to the battlefield commander. This system can see through haze and light cloud cover from oblique angles at medium and long range. This ability to "see deep" will help in battlefield shaping and strike planning. It will also provide for BDA at long range when direct over flight is not possible or desired. This externally carried pod also contains a data link that can down link EO-LOROPS imagery as well as the imagery collected by the primary internal systems of ATARS and the imagery obtained through the APG-73's reconnaissance strip map mode.

Figure 3-1: F/A-18F with ATARS installed.

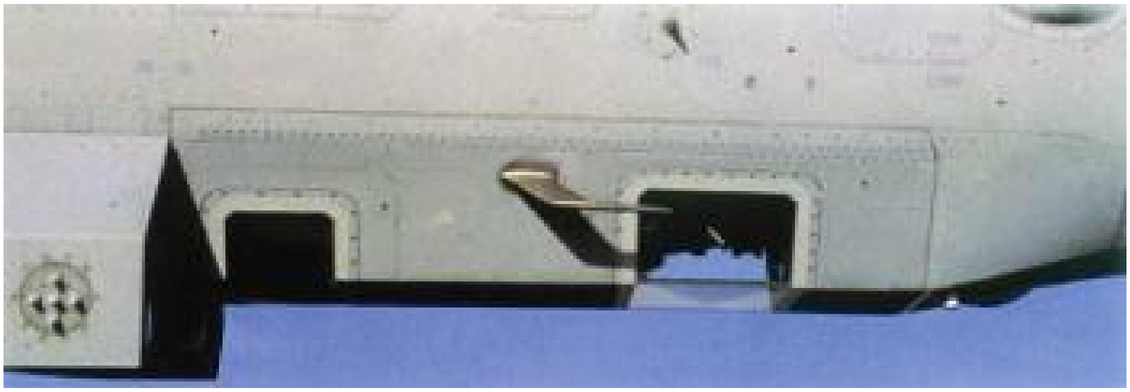


Figure 3-2: Close-up of ATARS enclosure on an F-18

4 – Shared Reconnaissance Pod (SHARP)

4.1 The **SHA**red **R**econnaissance **P**od or "SHARP" is the answer to a long sought solution to the needs for interchangeability, serviceability and versatility in a reconnaissance suite. The containing pod contains a vast array of sensing equipment that can be readily upgraded or changed out, as it is completely modular. Also the pod is approximately the size and shape of a 330-gallon external tank and can be fitted to almost anything that flies. Though it was specifically designed to integrate with the Hornet's airframes.

Figure 4-1: The F/A-18 and P-3 aircraft that carried the SHARP payloads. (a) The F/A-18 with the SHARP pod on the ground. The SHARP pod is carried on the centerline of the aircraft. (b) The F/A-18 with the SHARP pod flying over Washington, D.C. Note the pod window. (c) The NRL P-3 that also carried the SHARP payload. (d) A close-up view of the SHARP support system and the camera window on a P-3

4.2 The SHARP suite is capable of sensing and gathering visual and spectral information in many conditions of low-light, night, haze and dust from high altitudes or as low as 200ft. The pod has a rotating middle section that keeps a 12"x18" camera window aligned with the camera optics. The aft compartment has an environmental control system to cool the equipment and control other factors. The visible and IR images are compressed for storage or data linking. They are also down sampled as video signals that are displayed in the cockpit so that the crew can control the collection, storage and transmission of the gathered intelligence. Steerable antennae can direct the download of information in speeds exceeding 278 megabits per second. The sensor suite also integrates seamlessly with the LANTIRN and EO systems of the F/A-18 and is capable of recording their information as well.

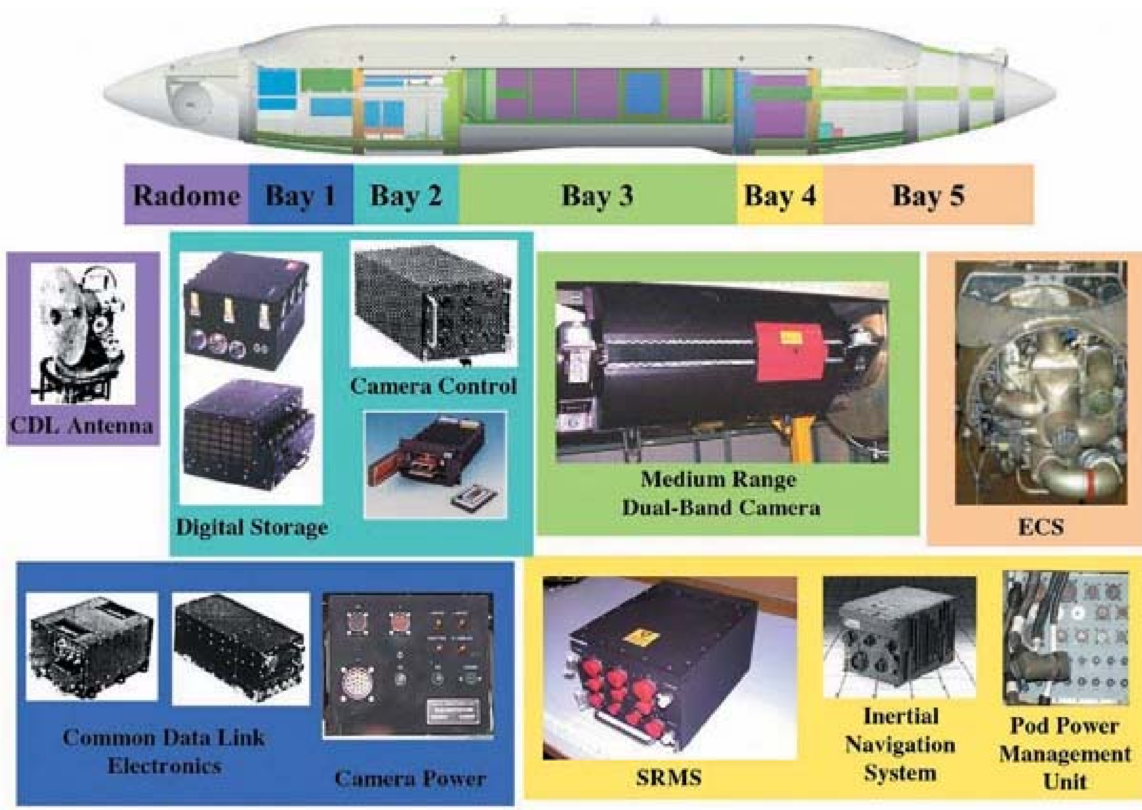


Figure 4-2: The layout and typical equipment in the SHARP

4.3 The SHARP is state-of-the-art and finally solves the problem of a versatile, upgradeable and interchangeable reconnaissance suite for years to come. It can read a newspaper at high altitude or while flying through its pages.

5 – Gathering the Images, Tactics and Considerations for Flight Simulator

5.1 Reality is one issue and flight simulation is another. In reality pictures are taken by a myriad of sensing suites in high resolution. Those images are then interpolated, cropped, zoomed and enhanced to accent particular areas of interest. Of note is the fact that almost all images (excepting those displaying spectrographic data) are produced in black and white. Color fools the eye and shapes can be broken up by shadows or paint schemes. Black and white and the necessary contrast allows discrimination between objects and backgrounds.

5.2 In flight simulation it is important to remember that your image resolution is limited to the pixels of your system. When one is flying a TARPS mission it is important to zoom to the level of detail before taking the screenshot. Blowing up an area of a 1:1 overhead frame from altitude will leave you with a mess of unreadable squares. We will deal more with image processing later, but for now we will deal with simulating the gathering of visual intelligence as realistically as possible.

5.3 Satellite imagery is common and can be gathered quickly. It is said that our satellites can read a license plate and recognize a face from orbit. Coverage of the earth is completed by several craft in overlapping orbits. The problem is that if you want a particular area you have to wait for the next over-fly. Contrary to what Hollywood would have you think, a satellite only looks down, has limited ability to adjust its focal center and **cannot** be moved from one orbit to another to get a real time image of a particular area…at least not within any reasonable time-frame. Simulating a satellite shot is more in the picture taking than in the tactics. Simply climb to altitude set your AP for course and altitude and switch to "Top Down" view (right click anywhere on the display and select "top down") zoom (+ key) just enough to pass the airplane leaving only the reticule. Take your shot.

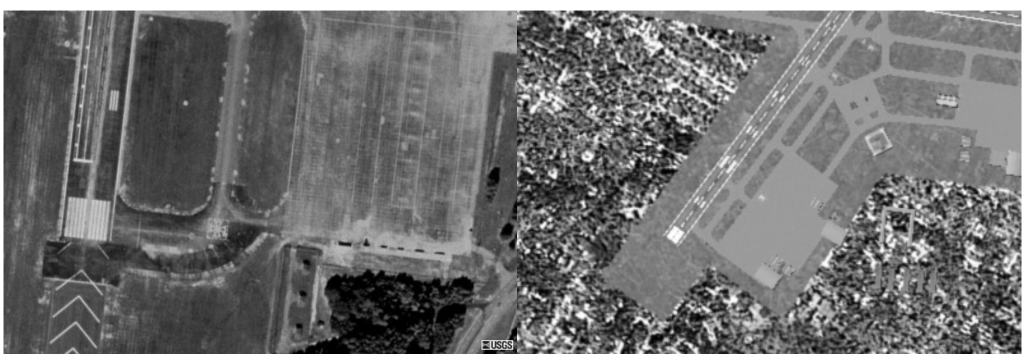


Figure 5-1: Approach end of RWY 1 at KNPA, USGS Satellite and one from FS9

5.4 The most important aspect of tactical aerial reconnaissance is to not only get to the target but also get home. One must determine the approach, ingress and egress course to minimize time over target as well as assessing the hazards. Air Defense Artillery, Combat Air Patrols and SAMs are all issues that need to be evaluated.

5.4.1 If one is to survey an airfield (for example) that is of interest and intelligence indicates that defenses are low or non-existent then a high altitude, high-speed overhead pass will do well. It will provide good situational intelligence, measure activity and provide mapping information. This is actually a common mission. Climb to a high altitude of FL 300 or more and establish a substantial air speed. Fly over the target and activate the sensing suite. If Intel was wrong you still have speed and altitude to counter surprises. BDA over a well-damaged target is well suited to this type of approach.

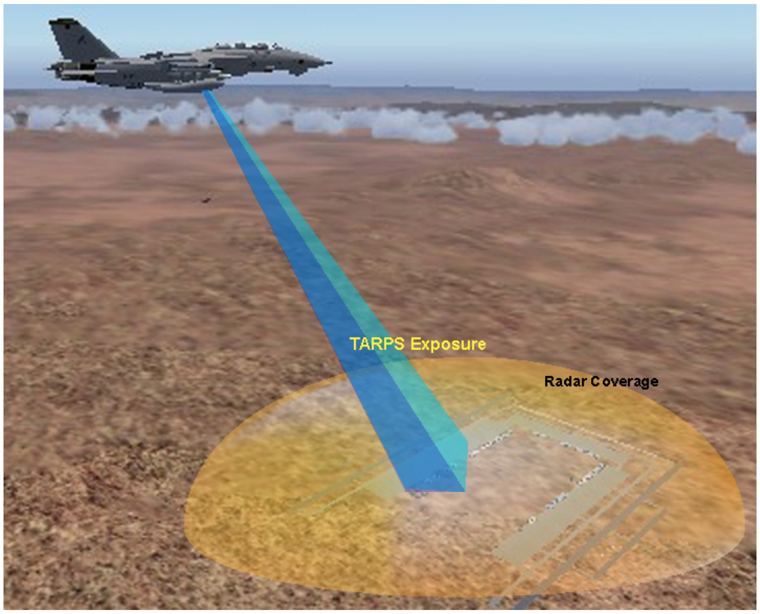


Figure 5-2: Overhead TARPS at altitude for a low risk target. NOT to scale!

5.4.2 Sometimes the target area is "hot" and an overhead pass at altitude would be foolhardy. So one must use the superior capabilities of our modern sensor suites and possibly employ an ECM aircraft as an escort. These missions are flown in such a way as to be outside of most radar sensing equipment and if not completely out of range, at the very limits of any SAMs should they be fired upon. The modern equipment can take highly detailed shots from miles away, weather permitting and this insures a good standoff capability.

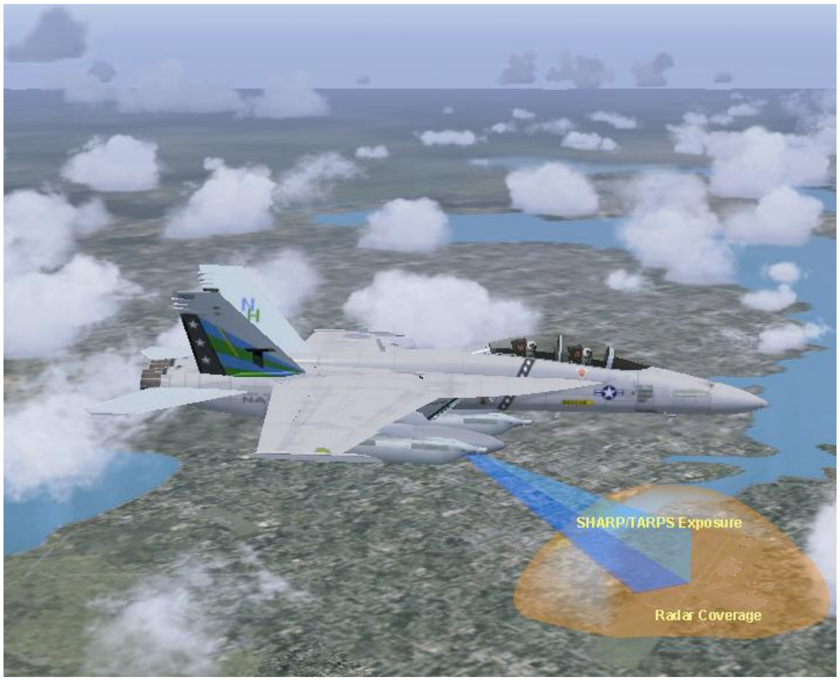


Figure 5-3: Showing flying outside of coverage area at altitude. The exposure is utilizing an oblique angle to cover the area of interest.

5.4.3 Sometimes the area is so “hot” that detection must be avoided at all costs and/or the weather prevents good acquisition from a safe distance. This is where the low altitude, high-speed pass is called for. Active radars are emitted from a single or an array of antennae. They work by a return signal being received and interpolated by the equipment. Also the beam like all radio beams travel in relatively straight lines. So if you can fly behind something solid, fly under the “gray out” area or keep yourself amongst so much clutter that you appear to be just so much “noise”; you can be in and out of the protected area before they knew you were there. Also, one should note that an AWACS also has problems picking out aircraft amongst the weeds. It can sense the movement but has difficulty in isolating the signal. A typical low altitude approach will have you at cruise altitude and on course to the target. Before you are within detection range you head for the deck (200-300 ft AGL ideally) and begin to use terrain masking. Hills, knolls and valleys are excellent for this purpose. Once you have flanked the target then you emerge and hugging the deck go “Buster” over and through the target area activating your suite when you can see the target. Turning and flanking the target area before emerging adds the advantage that the bad guys will be looking in the wrong direction if you did inadvertently throw a blip on their screen.

Figure 5-4: At altitude and inbound to target area. Note the mountain ridge just in front and below.

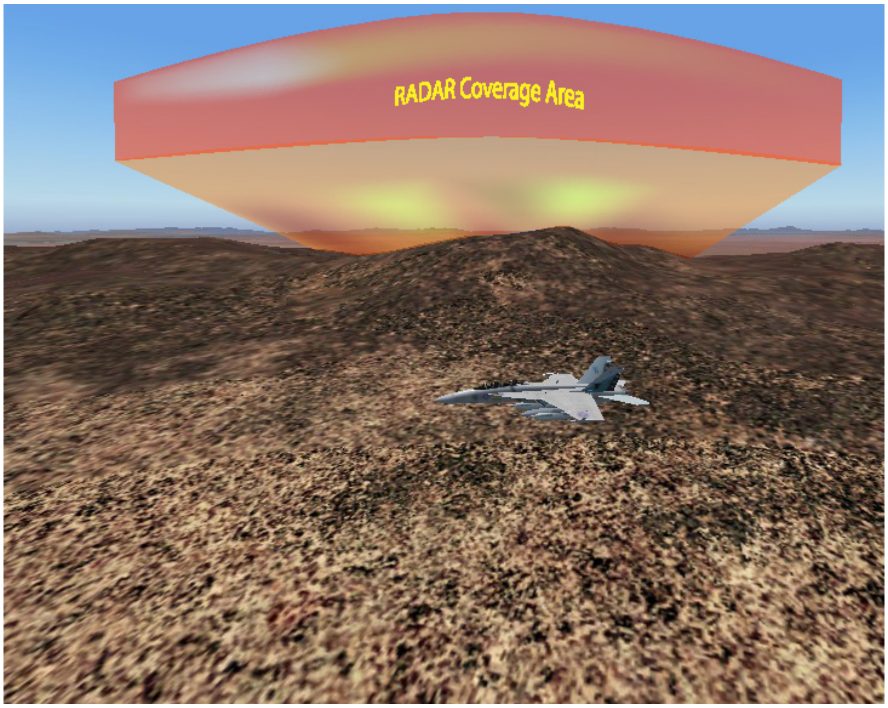


Figure 5-5: The target is close and at the A/Cs 3 O' Clock on the other side of the ridge. If they caught a glimpse of the plane initially they will be looking in the wrong spot.

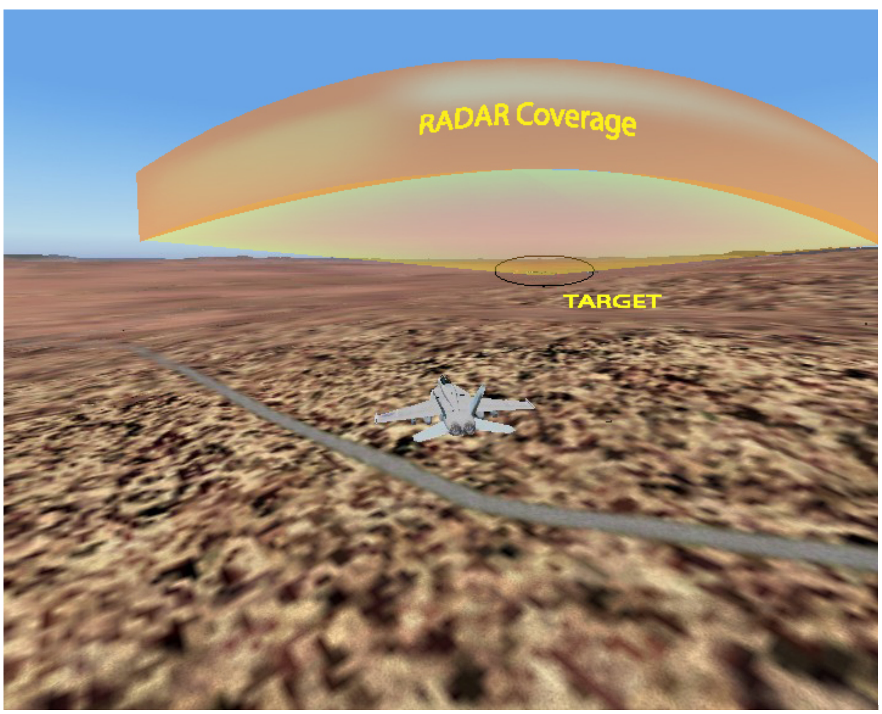


Figure 5-6: Emerging from between ground features and accelerating. The idea is to stay in the "gray out" below the Radar cone.

5.4.4 Battle Damage assessment is as important an intelligence tool as the initial reconnaissance is. Unfortunately, the scenery in Flight Simulator is minimally interactive. So there are only to ways to simulate BDAs. One is to turn back to target ASAP while the effects from the bombs are still playing and taking a screenshot from "Spot Plane" view and from an upper POV. Then you can crop and edit the picture. The other means is to fly an overhead TARPS and edit the picture in processing. This is more complex, requires at least a mid-line editor and can lend itself to embellishment.

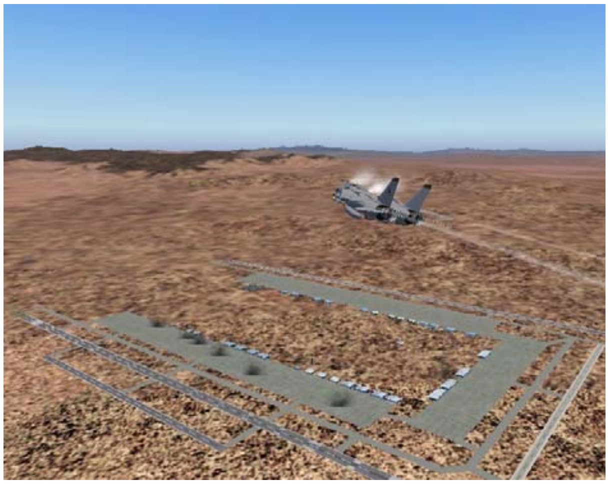


Figure 5-7: Raw screenshot for BDA, cropped.

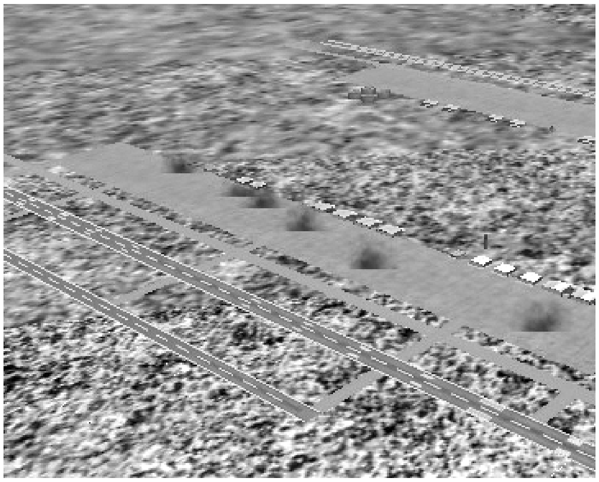


Figure 5-8: BDA Screenshot cropped, in grayscale, blurred and adjusted for contrast.

***NOTE:** The next images are of a standard overhead shot of the same area. They were then cropped and the effects were added with the tools in Adobe Photo Shop. Many basic editing packages that come bundled with cameras are capable of similar results though many are not. It is best to get a decent editor if you intend to pursue the advanced simulation of reconnaissance photography. If budget is a concern, the author highly recommends going to Half Priced Books and seeking out older versions of Photo shop or Corel Photo. Also know that if you have Microsoft Office installed, Photo Paint can duplicate many of the effects in this paper. The specifics of image processing will be covered in the next section.

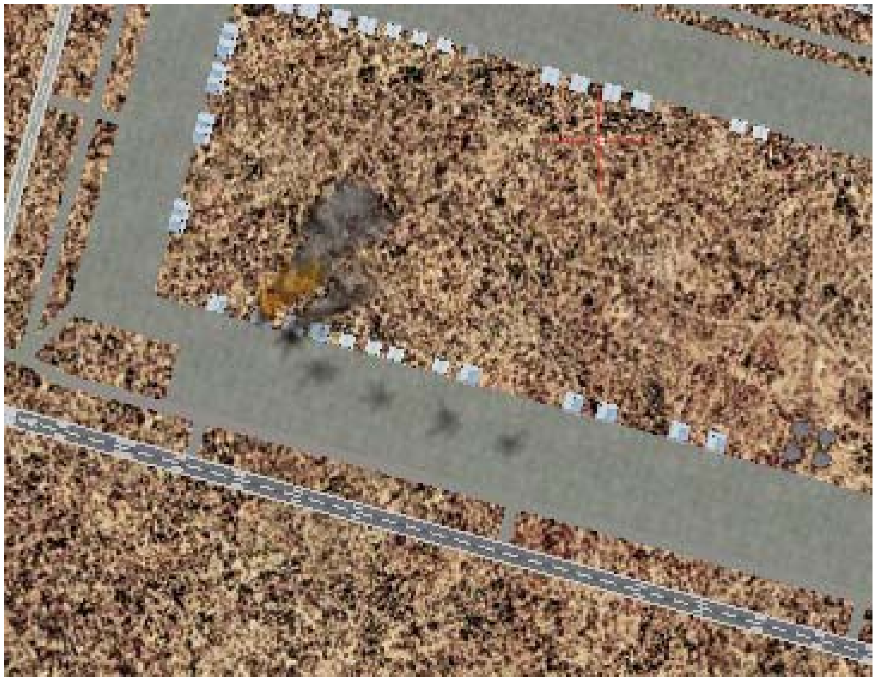


Figure 5-9: Overhead screenshot, cropped with added effects of bomb hits.

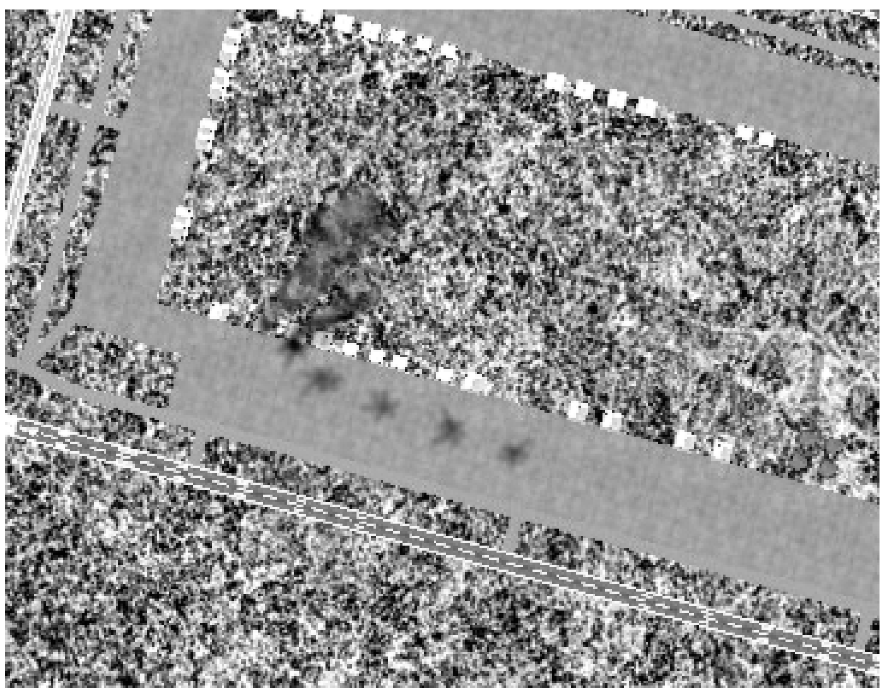
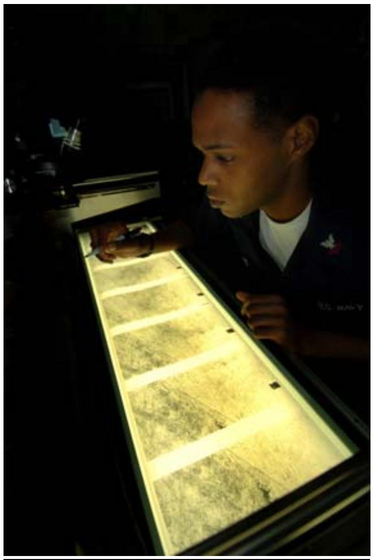


Figure 5-9: The same shot in grayscale, a little Gaussian blur and adjusted for contrast.



6–Image Processing. All the advanced sensing suites, digital compression and gutsy pilots in the world do not make the images taken into useful intelligence information. The data has to be *Interpolated*, combined into legible visual and spectrographic information and then *Interpreted.* Interpretation is the art of pouring over images and data and looking for what is "…wrong with this picture," and then deciding on the significance.

The men and women that labor tirelessly at this task are highly motivated, extremely intelligent, observant and intuitive. They spend countless hours meticulously examining TARPS, satellite and BDA photos for the smallest of details and then compiling the data into a concise analysis.

Here you see CPO-2 Damon Jenkins on board the U.S.S. John C. Stennis aircraft carrier examining high altitude TARPS photos from an F-14 over Iraq. If you look closely you can see the progression along the flight path in the photos. *From "In the Fleet" Naval News service.

6.1 The techniques for simulating tactical reconnaissance in Flight Simulator is not all that complicated. The problem is in reality you would have a RIO or Photographer's Mate running the sensing equipment and framing the shots. Also a whole crew of processing personnel to select, crop and zoom. Finally the sensing equipment used dictates the appearance. In Flight Simulator you do not have that luxury but you do have an autopilot and a pause button and hopefully, a photo editor of some type. So we will be looking at the specific methods for simulating particular types of photo missions while getting what you need and still maintaining a degree of realism.

6.1.1 Simulating the satellite shot is the most mundane (read "boring") but sometimes the most important of initial reconnaissance measures. It provides an overall situational picture and mapping information but is simply straight down. Simply climb to altitude, set autopilot for the altitude you want to fly and on a course that will take you directly over the target. As you near the area, right click on your screen and select "Top-Down View", this will switch you to a map view at a default of 10 miles AGL. As you come over the target area press the "+" or "-" keys to set the zoom where the desired area comes close to filling the frame. As the red reticule (position indicator) passes over or near the center of the target area, take your screen shot. Then in your editor simply crop it to size and edit it as you wish.

Figure 6-1: "Satellite" pass over KNPA. Cropped to 8"x10" and no further editing.

Figure 6-2: A reasonably "attractive" satellite image. The raw screenshot was cropped to 8x10. In Photo Shop Image>Mode>Grayscale was selected. Then Image>Adjustments>Brightness and Contrast and then the sliders adjusted to my liking. You can also add type and filter the image for noise and blurring.

6.1.2 An overhead TARPS run can be done pretty much the same way but I prefer to set up on a course and altitude passing close to but not directly to ground zero. Then I'll cycle my views until I'm in spot plane mode and pan to a position above and off to the side of the aircraft. I'll pan and shoot as the plane makes it pass and then select the screens and crop them to center and emphasize the area of interest. I'll add text and frames to markup the picture as well.

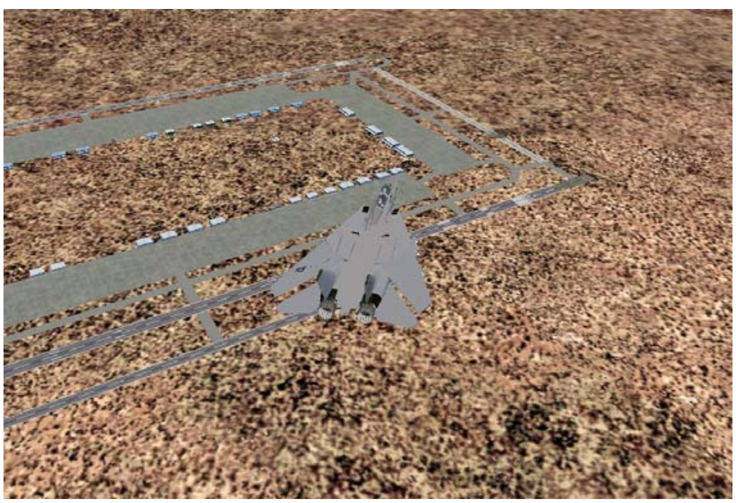


Figure 6-2: Raw Overhead TARPS at 10000 ft AGL.

Figure 6-3: F-14 Overhead TARPS, cropped. Grayscale Mode with rudimentary markup.

6.1.3 Oblique shots simulating a fly-by TARPS mission are conducted a little differently. First in Flight Simulator go to Views>View Options>Axis Indicator and select the 4 dots. This set up will be the one you use for all the other reconnaissance simulations. You probably will not be able to see the axis indicator with the cockpit on. Climb to altitude (FL300 +) and set a course to fly *by* your target. As you near the area press Shift+Z to display an information line with position, altitude, heading and airspeed. Then go to Views>Instrument Panel>Global and uncheck it. You will now have an unobstructed view. If the target is ahead, dip the nose to center it on the axis indicator, press the plus or minus keys to adjust your zoom and take a screen shot. Next as you begin to pass the target select your 45-degree POV and bank slightly to position the target then shoot again. As you pass by select the side POV and bank to position the target and shoot again. Then you can select, crop and edit the shots to look like TARPS photos.

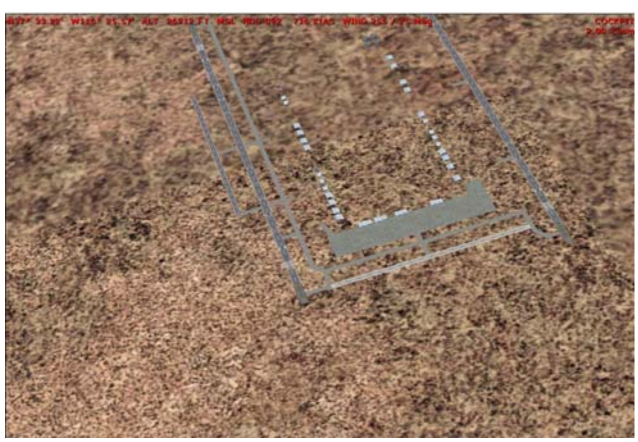


Figure 6-3: F-14 Fly-By @ 26,000 ft. and 5 miles. Global off, side view with bank and zoom @ 3.00

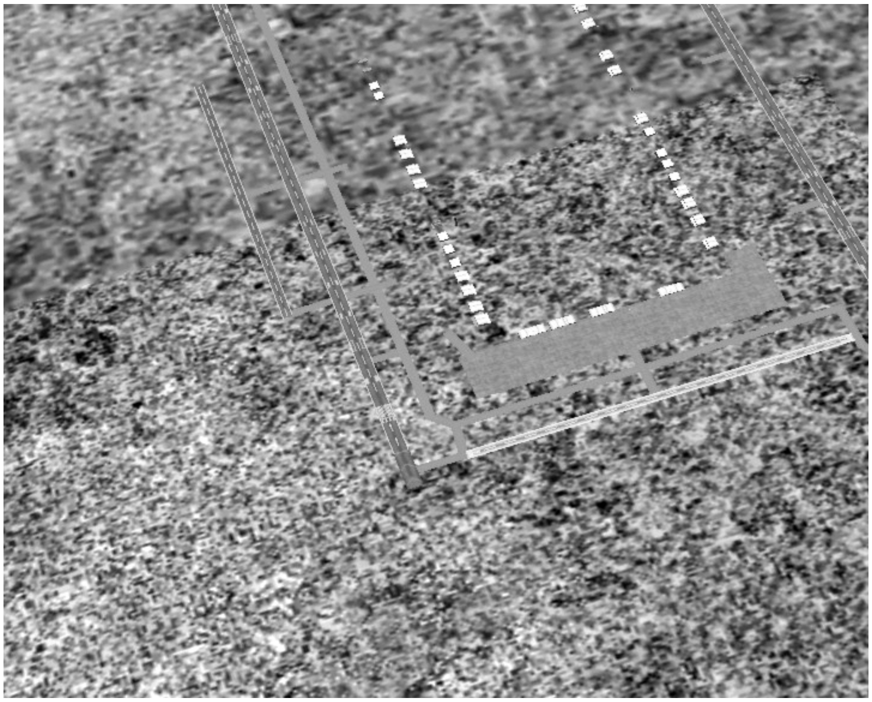


Figure 6-4: F-14 TARPS pass from above. Cropped to 8x10, grayscale mode selected. Contrast adjusted and a .6 pixel Gaussian blur selected.

6.1.4 Composites are sometimes necessary particularly when a TARPS or SHARP pass is at low altitude and looking straight down. Below are two (color) overheads of the GW. And then the composite. Taken while at low altitude (826 ft) and looking straight down. Note the reticule positions in both shots.

Figure 6-5: To low level TARPS shots, single pass, raw screenshot.

Figure 6-6: Above TARPS shots, cropped and as a composite for a more complete image.

6.1.5 Video is a simple "gun camera" view and runs as you fly over a target. The intelligence processing personnel can then select captured frames and run a progressive scan of the images. In Flight Simulator, select the view options and settings described in section 6.1.3. Fly toward the target at low level and start snapping screenshots when the target comes into view. Select the screens you want, crop to the format of your choice and open in your editor. In Photo Shop select >Filter>Noise>Add Noise. Use the sliders to adjust the percentage until you have a grainy effect simulating high-speed video.

Figure 6-7: "High Speed" noise selected. Text must be added last or on separate layer.

6.2 There are circumstances and sensing types that you may want to simulate that are: a) not supported in Flight Simulator and b) require advanced editing techniques in your photo editor. What follows was completed in Adobe PhotoShop 7.0.1. The menu selections should be roughly equivalent to those in older and later editions. The capabilities and process selections vary somewhat from editor to editor. I recommend that you get a decent editor with advanced capabilities like PhotoShop or Corel Photo. Half Priced Books and Ebay are excellent resources for getting modern, if not the latest editions for greatly reduced prices.

6.2.1 LANTIRN (Low Altitude Navigation and Targeting Infra Red for Night) is a sensing suite that almost all modern fighters have. It uses both a passive IR, light gathering and an active IR (Illumination in the IR band) to synthesize a video image that the pilot can view in the cockpit. It provides an accurate picture of the outside world so that an aircraft can be piloted safely at night and *LOW* altitudes. If the pilot climbs to altitude the LANTIRN signal degrades and he has to defer to FLIR for his visual of ground targets. As LANTIRN produces an excellent image at limited range it is perfect for gathering target images during high-speed passes at low altitude during the night. The only reason the bad guys will know you were there is when the feel the breeze and the thump as you pass through. The LANTIRN image has a characteristic yellow green cast (a result of the night viewing optics and the video signal interpolation) and a “hot spot” from the active IR illumination.

6.2.1.1 For best results have your time set to “Dusk” so that the colors will be muted. Again, select your view settings according to section 6.1.3. As you close on the target take a series of screen shots. Select the one you like the most and crop to size. Then there are two ways to proceed. The first is in color mode, Select Image>Adjust Image>Hue and Saturation and shift your hues toward the blue end of the spectrum and de-saturate the image slightly. This will render a cool night-like image. Next select Filter>Render>Lighting Effects. Then select the desired pattern. If it’s a straight on view I use “Omni” if oblique or looking down from a front view I use “Spotlight”. The ultimate choice is as much a matter of taste as it is realism. Then adjust the intensity and ambience to highlight the center of your image while dimming the periphery. Next add a layer and fill the entire image with a yellow green of your liking. Then adjust the layer’s opacity until you have accomplished the best balance between a green cast and legibility. Next add a third layer to add your text.

6.2.1.2 The other way and in my opinion, a more realistic end product is completed by taking the same cropped image, selecting Image>Mode>Grayscale; select “Yes” when asked if you want to discard all color information. Then I will select Image>Adjustments>Brightness and Contrast and adjust both qualities to obtain a muted but legible image. I will then add the lighting effects as I did in the color version. THEN before I proceed I re-select Image>Mode>CMYK (RGB color if you prefer); otherwise the subsequent layers will be rendered in grayscale…the base layer will remain black & white. Then add your color layer and finally your type layer.

Figure 6-8: Image simulating LANTIRN, color and desaturated as described in 6.2.1.1

Figure 6-9: Same image prepared in a grayscale base layer.

6.2.2 The EO suite in most aircraft has a three-fold purpose. It will find a target, designate a target and guide a weapon to a target. The two main types of EO sensors are the FLIR (Forward Looking Infra Red), which will aid in the selection of a target and the guidance of an IR guided weapon like the AGM-65 Maverick. TVO (Targeting Video Optics) is used to designate a target and guide a missile such as an AGM-62 Walleye which is a gliding bomb that a pilot literally steers onto the target.

6.2.2.1 Simulating a FLIR type image is rather straight forward though one must apply "airbrushing" to the image and therefore requires a little practice. Also one must be careful no to get carried away. In real life the pilot can select "WHTHOT" where the higher the temperature the brighter the hot spot and "BLKHOT" which is just the opposite. The limitations of PhotoShop mandate the selection of the latter. The purpose here is to simulate a heat signature enhancing an area of interest in a target area as well as simulating "life". The image should be cropped and then converted to "grayscale" as described in preceding sections. Then select Image>Adjustments>Invert and click. The picture will now appear as a black and white negative. Select Image>Adjustments>Brightness and Contrast and adjust until the grays go one-way or the other. Then select the Paintbrush>Airbrush and select the pixel size you want depending on how much you want to cover. Also select a lower opacity around 35% or so; this will allow you to feather and blend the areas. Select black for both the outline and fill. Then figure out where your hot spots and plumes will be and add the color. Darker where hottest and less where warm but not as hot. Then add a second layer and use the line tool (I selected 3 pixels line weight) and white for your outline and fill. Draw your "kill box" reticule. Then select your rectangle tool and draw a small square to represent the laser "pipper".   In the example that follows I centered the image, kill-box and "pipper" so that they were on an open area. This simulates a standby. Of course you can position the target so that it is centered as well as move the "pipper" a bit so that your target will appear locked. At that point I would add that text to the upper right-hand corner of the image.

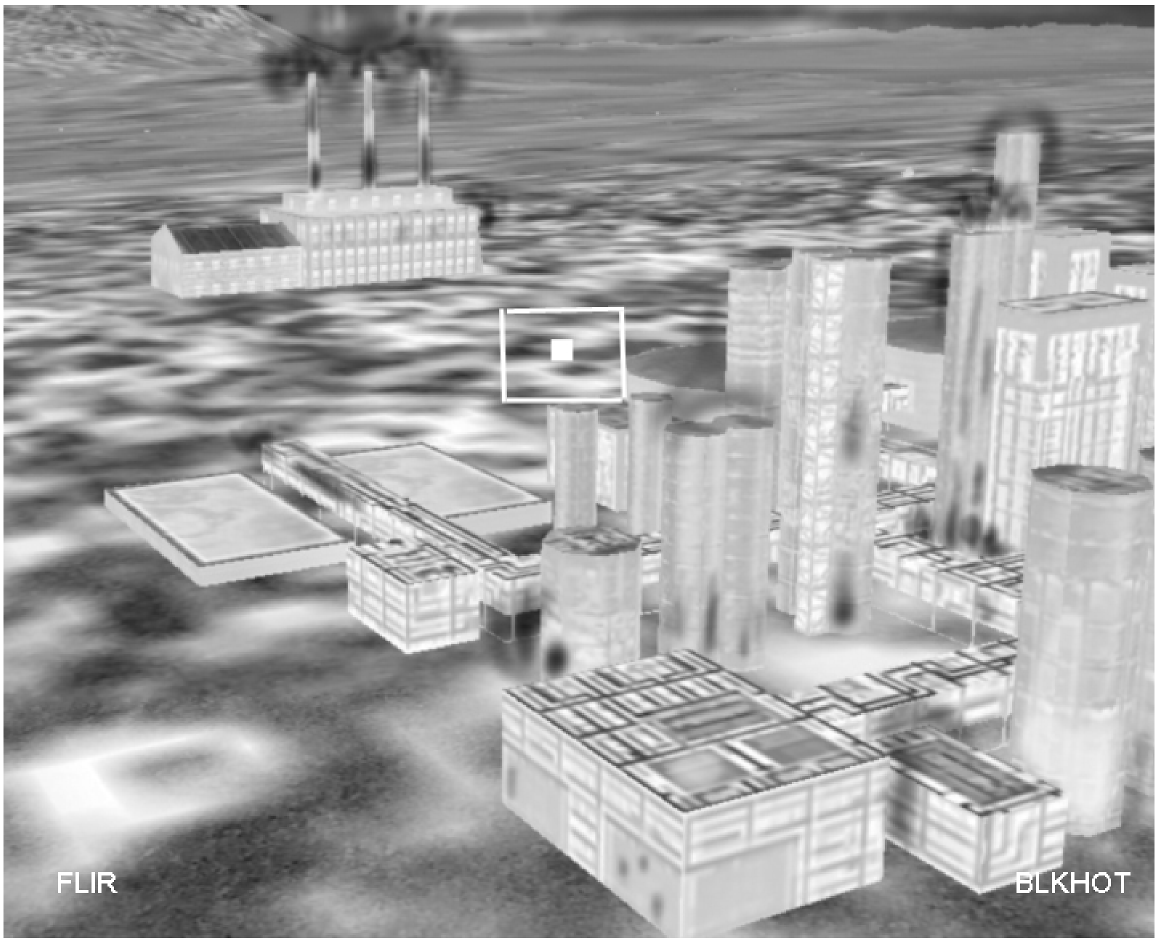


Figure 6-10: Simulated "BLKHOT" FLIR Image. Note the adjustments to the sky at the horizon.

6.2.2.2 To simulate a TVO type sensor image you would then take an image in daytime or at dusk. Crop the image, add a bit of noise like you did in the "video" shot and then convert the image to grayscale. I then added a white cross hair in the center. Then, as you did in the LANTIRN shot add a second layer to give the image a green cast. Then you add another layer to draw the display's reticule. I used the line tool at a 3-pixel line weight and a yellow-green color (it has to be bright enough to distinguish). I then added a laser "pipper" and the appropriate text. As in all images you can add text to label the contact directly on the image but for something like this it would be attached to a dossier with the pertinent information. Also if you save a copy in PSD format you can "lift" the layers such as the reticule and green cast and apply them to subsequent shots of the same proportion. This will save an immense amount of time. You can even save the layers as separate PSD files for easy selection and application.

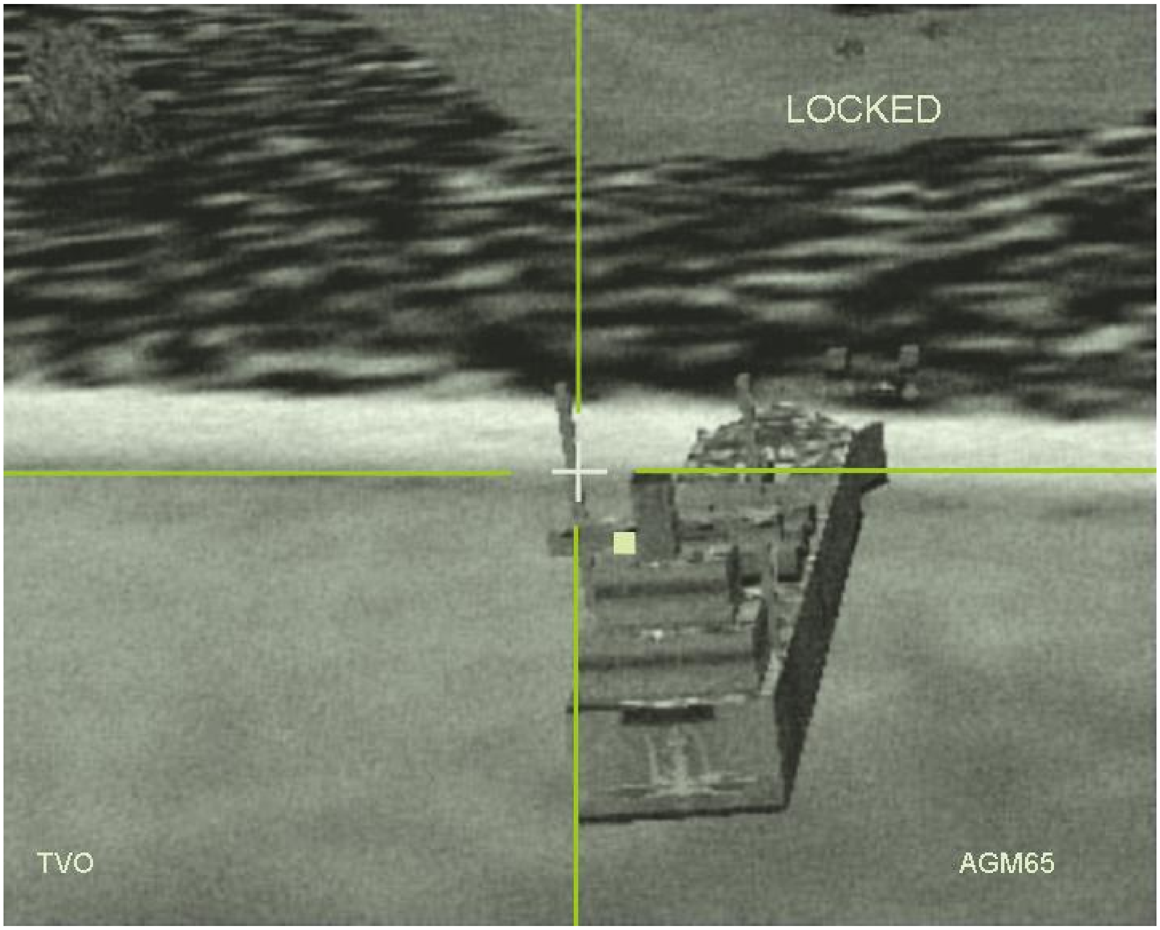


Figure 6-11: Simulated TVO Image acquisition. Maverick selected and target locked. Pipper is more yellow and toward the white end of the hue, the text more green and toward the whiter hues.

7 – BDA Simulation and a Few Closing Comments

7.1 Unless you are doing these shots for fun, you should be prepared to produce *in situ* screenshots to document the hits. As with the other advanced editing techniques, personal preference is the rule. However one should avoid overdoing it and/or exaggerating the results. For smoke and fire effects as well as blast marks you should use the airbrush tool at less than 50% opacity. Build your layers subtly and blend the smoke with the fire. Looking at photographs of building and fuel fires helps but the real expert guidance comes from looking at Anime…those guys know how to draw explosions and fire!

7.1.1 In the image below, I started with the oblique TARPS fly-by with the F-14. I cropped the area I wanted to proportion and blew it up to 8x10; no noise was added as the image pixilated slightly. I then added about a .6 pixel Gaussian blur. I first selected the airbrush in black and feathered blast marks on the TARMAC. I then “damaged” respective corners of the two hangars with black. I used black and white to add smoke to the first hangar. Then I added a brick red plume to the next and blended in red>orange>yellow and then added smoke to that one simulating a fire.

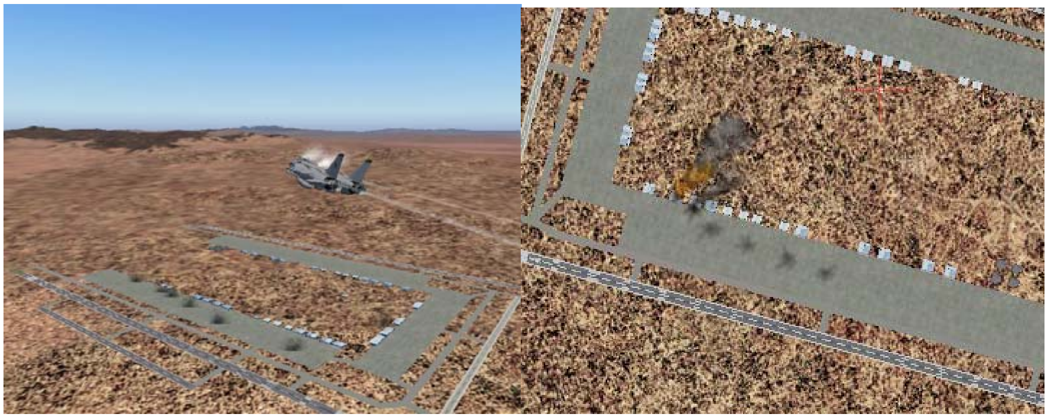


Figure 7-1: BDA Pass showing "actual" hits and then the original TARPS shot modified to <u>simulate</u> a BDA TARPS pass.

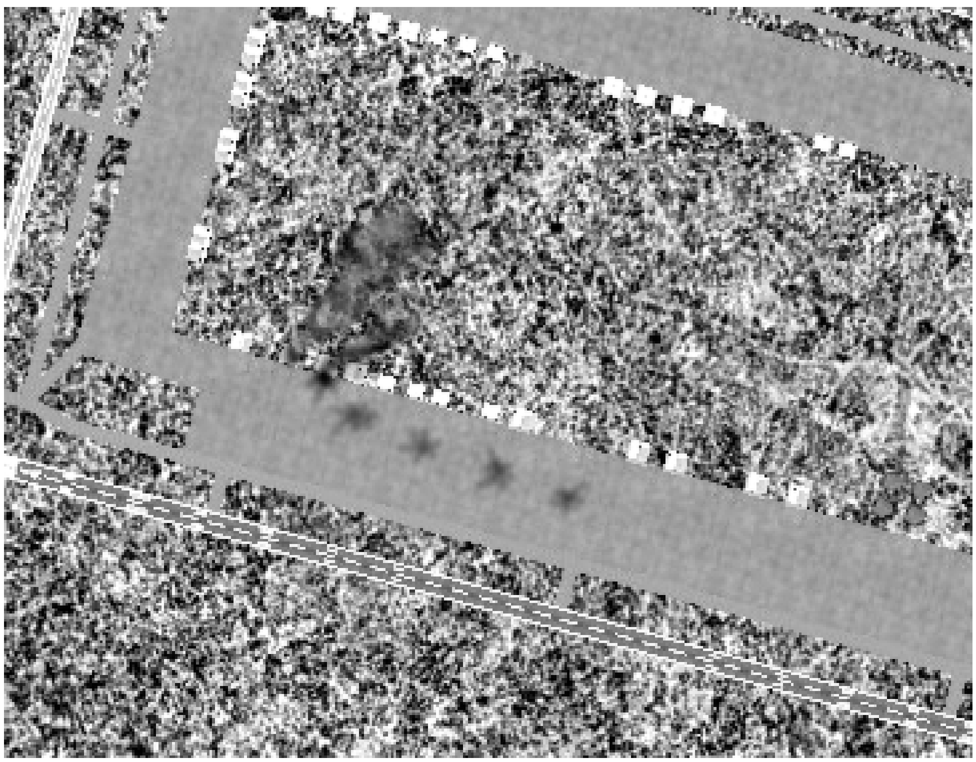


Figure 7-2: Gray scaled version of the above modified shot.

7.1.2 The same thing can be done with ACM screen shots but once again, appropriate documentation would be expected. Simply clean up the shot, paintings out aircraft titles, crop to taste, add smoke trails and or fires and then add noise to simulate a gun camera's "video" capture. In the following example I used a shot of formation flight with "Navy 2" and added orange and red to the engine glow and added the smoke trail. Notice I did not overdo the smoke; subtlety is the key to realism. No noise was added and it appears to be a simple out the window shot. Had this been a "kill" screen I would have included the radar and HUD view. I probably would have added a detached smoke plume to indicate the hit preceding the damage along with a chunk or two flying past. As it is it is an escort of a wounded comrade photo.

Figure 7-3: Escorting a wounded Navy 2.

7.2 Remember when you're doctoring screen shots to be subtle. Utilize other photos and artists' work to get an idea how something should look. If you see something you like in an aviation photo, try to duplicate it with Flight Simulator and your photo editor. Even the most rudimentary techniques covered in this paper will greatly enhance the impact and legibility of your reconnaissance photos and will add great fodder for your websites and mission reports. Of course this treatise is hardly exhaustive and your own imagination will dictate how far you can go. For me it has become a hobby within a hobby. I hope you have enjoyed this paper and I hope this helps you in producing realistic simulations of reconnaissance and BDA pictures and even enhancing routine shots like traps and deck landings.

CPT Kyle Cowden, CAG
CVW-11