Camouflaging Vehicles Using Field Expedient Materials, Commercial Hardware Store Materials, Camouflage Nets, and Rubber Conveyer Belt Material

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Analysis of FLIR Imagery of Field expedient Camouflage Systems on US Army Vehicles

In June of 2001, the US Army CERDEC NVESD camouflaged several vehicles for a FLIR field test at a wooded US Army test site in the western United States. The vehicles were camouflaged using field expedient camouflage materials, commercial hardware store materials, and standard camouflage nets. The camouflage materials were augmented with pieces of rubber conveyer belt material as observed being used on tanks in Serbia and Bosnia. The camouflage was placed on 3 US vehicles and Long wave FLIR imagery was collected at various ranges. The effectiveness of the camouflage treatments was analyzed.

1.0 PROGRAM SUMMARY

This program began based on pictures obtained in Bosnia and Serbia that showed that the Serbian and Bosnian Armies were covering their T-55 tanks with camouflage netting and a rubber material, determined to be conveyer belt material from local sand and gravel pits.

The Serbians and Bosnians were claiming that the material suppressed the thermal signature of their T-55 tanks. This claim, if true, could make them harder than standard tactical vehicles to detect and target with infrared sensors.

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Figure 1a and 1b Bosnian and Serbian Mobile camouflage

In order to make a determination as to the effectiveness of this approach to thermal camouflage, a field test was conducted to collect short and long-range thermal infrared imagery. Advanced FLIR systems were used to collect imagery of various types of military vehicles with and without simple mobile camouflage measures. The data would be used to analyze the effectiveness of the camouflage on sensor performance. The camouflage techniques to be tested were field expedient and depot level materials, augmented with the Serbian/Bosnian style conveyer belt materials and standard camouflage netting.

2.0 TEST DEVELOPMENT

The test was conducted at a US Army test site in the western United States. The terrain is a natural combination of heavy woodland and meadows, rolling small mountains and hills. The sensors were located on top of a small mountain providing some elevation, as shown in Figure 2, and the targets were positioned down range at various distances starting at 1 km and going out to 8 km. The target locations were marked and staked using GPS positioning and one of the FLIR systems was utilized with which it was determined that each target at each location was detectable.

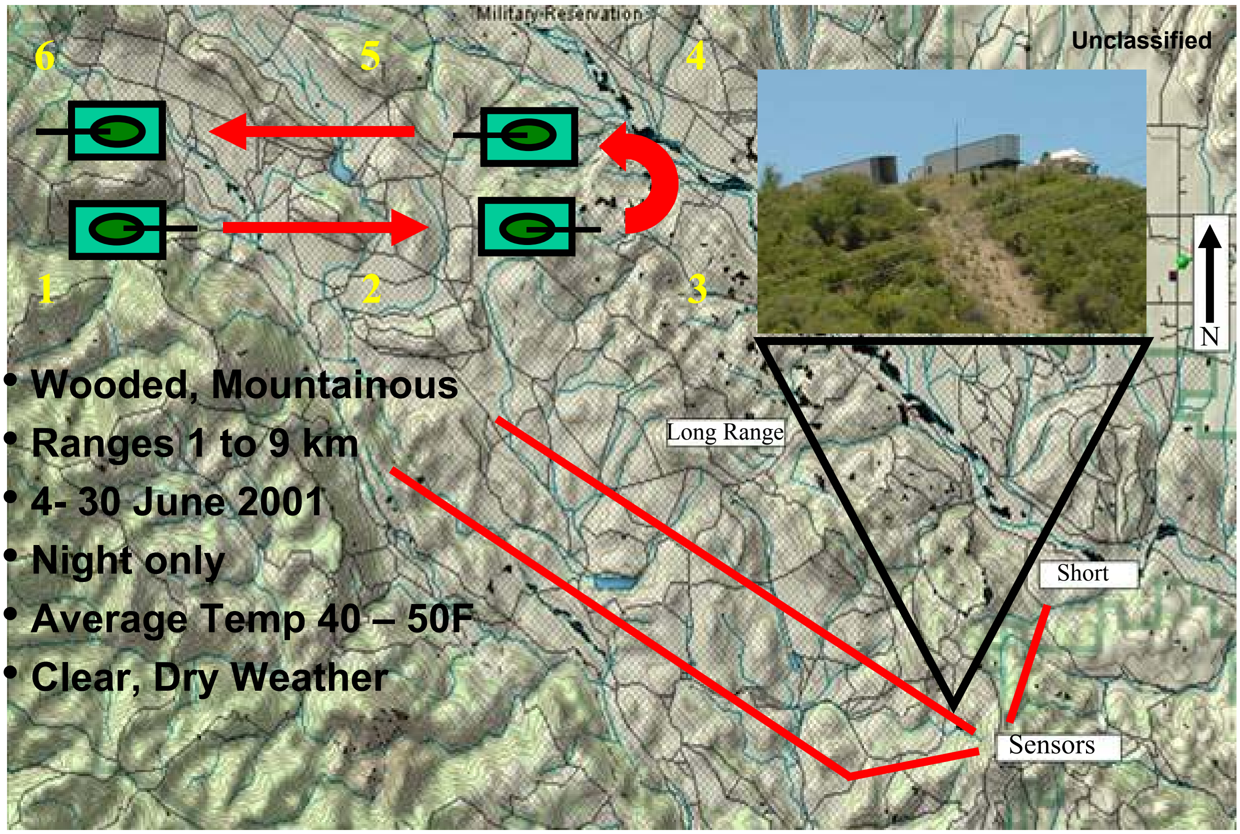

Figure 2. Sensor Location and Target Range

Normally two (2) locations were established for each distance, one in the open and the 2nd against a tree line. Two (2) stake positions were located at each range position separated by about 100 meters, for example position 7A and 7B. The second stake or B stake was separated from stake A by a distance of 110 m or approximately the distance that could be travelled at 10 km/h in 20 seconds. The vehicle was moved into position A and measurements were taken, then the vehicle travelled to position B. Infrared images were taken as the vehicle moved from A to B at 10 km/hr. The vehicle would then stop at stake B and additional imagery was taken. The vehicle would then turn 180 degrees and the test sequence would be repeated for the opposite side of the vehicle. The vehicle is usually imaged from both sides because the vehicle is usually not identical on the left and right side. For example, the LAV 25 has the engine exhaust on the right side; therefore, the right side is considerably hotter than the left side.

3.0 SENSORS

The sensors used in this test, see Figure 3 and 4, were an NVESD Long wave FLIR which is an 8-12 micron FLIR system with a 6" lens, 480 horizontal lines, the Amber FLIR which is a 3-5 micron FLIR camera, the Agema FLIR which is a calibrated 8-12 micron camera, the standard Army 1st Gen FLIR system which is an

8-12 micron system with a 1st Generation detector with 120 detector elements, and an Army Research Laboratory (ARL) Two Colour FLIR which is a 256x256 line pixel registered 3-5 and 8-12 micron FLIR system with both detectors on the same focal plane array All of these sensors have been configured to record their imagery in real time on high-speed hard disk drives.

Figure 3 and 4. NVESD Agema Calibrated FLIR, Amber FLIR and the inside of the NVESD Sensor Trailer.

Figures 3 and 4 show the inside of the NVESD sensor trailer. Figure 5 is a picture of the ARL 2-color FLIR that was mounted on a separate trailer. It shows some of the test range terrain in the background.

Figure 5. Army Research Laboratory 2 Color FLIR and terrain

4.0 CAMOUFLAGE TECHNIQUES

The following vehicles were used in the entire field test: M2A2 Bradley, LAV-25, HMMWV, T-72, BMP, BTR-70, BTR-80, and a BRDM. The camouflage part of the field test used 3 vehicles, the M2A2 Bradley, LAV-25, and a HMMWV, see Figure 6. The LAV-25s were provided by the US Marine Corps.

Figure 6. Bare M2A2 Bradley Infantry Fighting Vehicle, bare LAV-25, and bare HMMWV.

Figure 7 and 8. HMMWV with thermal insulation, camouflage netting, and conveyer belt material

Pictures of some of the vehicles, and camouflage treatments that were tested, are as shown in Figures 6, 7, 8, 9, and 10. These were referred to as bare, field expedient camouflage (FE), and depot level camouflage (DLC). The FE camouflage was a sample of what a unit in the field could be expected to do with some camouflage netting, wire, and conveyer belt material. The depot level camouflage was somewhat more extensive, and was an example of what could be done with access to common construction materials available at depot or depot level warehouse.

The HMMWV depot level camouflage, Figures 7 and 8, used double layers of aluminized bubble wrap insulation with camouflage netting and the conveyer belt material over the wheel wells and grill.

Figure 9a and 9b. M2A2 Bradley with depot level camouflage - conveyer belt over the vehicle surface augmented by a Colebrand (UK) Solar Blanket, and 2 types of US Camouflage Nets, the LCSS (Lightweight Camouflage Screen System) and ULCANS (Ultra Lightweight Camouflage Net System)

Figure 9 shows the M2A2 Bradley with depot level camouflage. First the conveyer belt material was placed on the vehicle. Holes were drilled into the rubber mat and the pieces were held in place with standard copper electrical wire. Colebrand (UK) thermal solar covers purchased by PM-Bradley were installed on the turret and deck. Finally pieces of the 2 camouflage nets, the LCSS and ULCANS were draped over the vehicle.

Figure 10 and 11. Depot level camouflage on the LAV-25 consisting of conveyer belt material over the wheels, pieces of ULCANS camouflage netting over the vehicle and with an insulated wooden box over the engine air intake area.

Figures 10 and 11 show a similar installation of camouflage on the LAV-25, except that no Colebrand solar covers were available or installed on this vehicle. In Figure 11, the conveyer belt material was used to cover the top of the wheels and the wheel hubs that get hot when in operation.

5.0 IMAGERY

The following pictures show short-range (1000 meters or less) night time infrared imagery of these targets. All the images shown are AGEMA Long Wave FLIR wide field of view (WFOV) imagery.

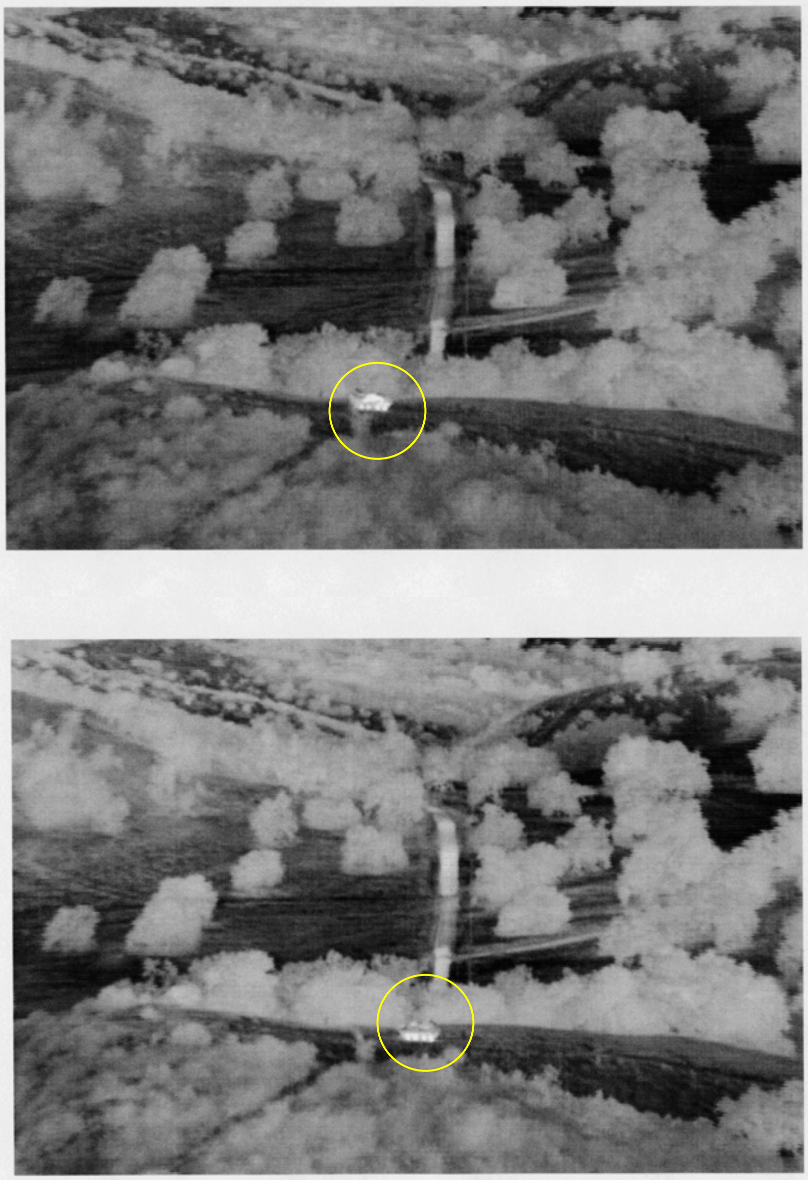

Figure 12. Long Wave FLIR image, Bare LAV, Right Side/Left Side

Figure 12 is a Long Wave FLIR image of the bare LAV in WFOV. The vehicle is stationary, the range is 1 km. The right side has the hot exhaust and there is no camouflage. Notice that the vehicle is easily detectable with the turret and hull discernable.

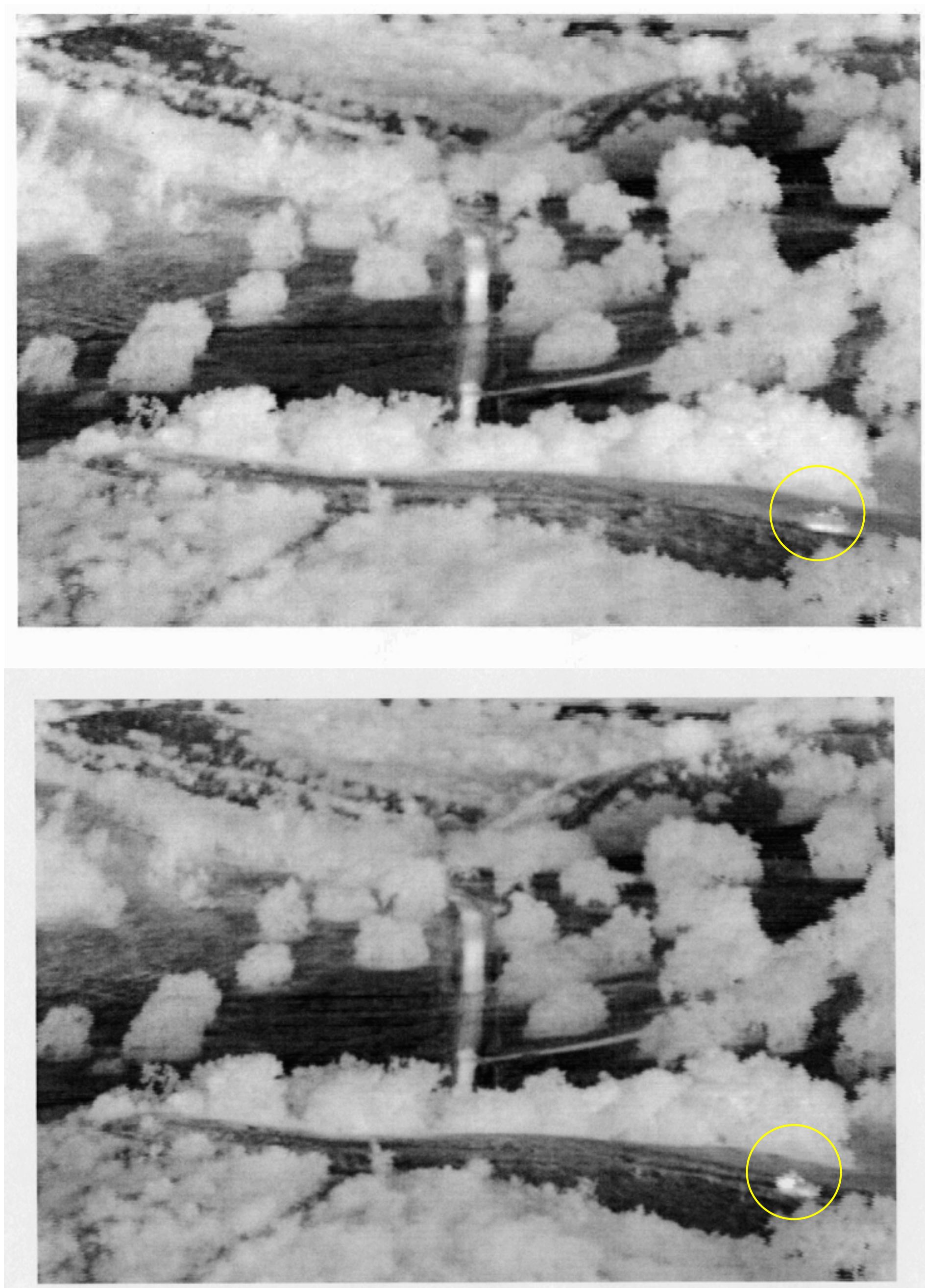

Figure 13. Long Wave FLIR image, LAV-25, Left Side/Right Side, with depot level camouflage

Figure 13 shows the Non-exhaust (left side) and hot exhaust side (right side) of the LAV-25 at 1 km. The LAV-25 has depot level camouflage. Part of the vehicle is thermally hidden. The hull and turret are not easily discernable. The depot level camouflage helps to reduce the thermal signature but does not eliminate it. The hot exhaust is detectable and defeats the attempt at thermal camouflage.

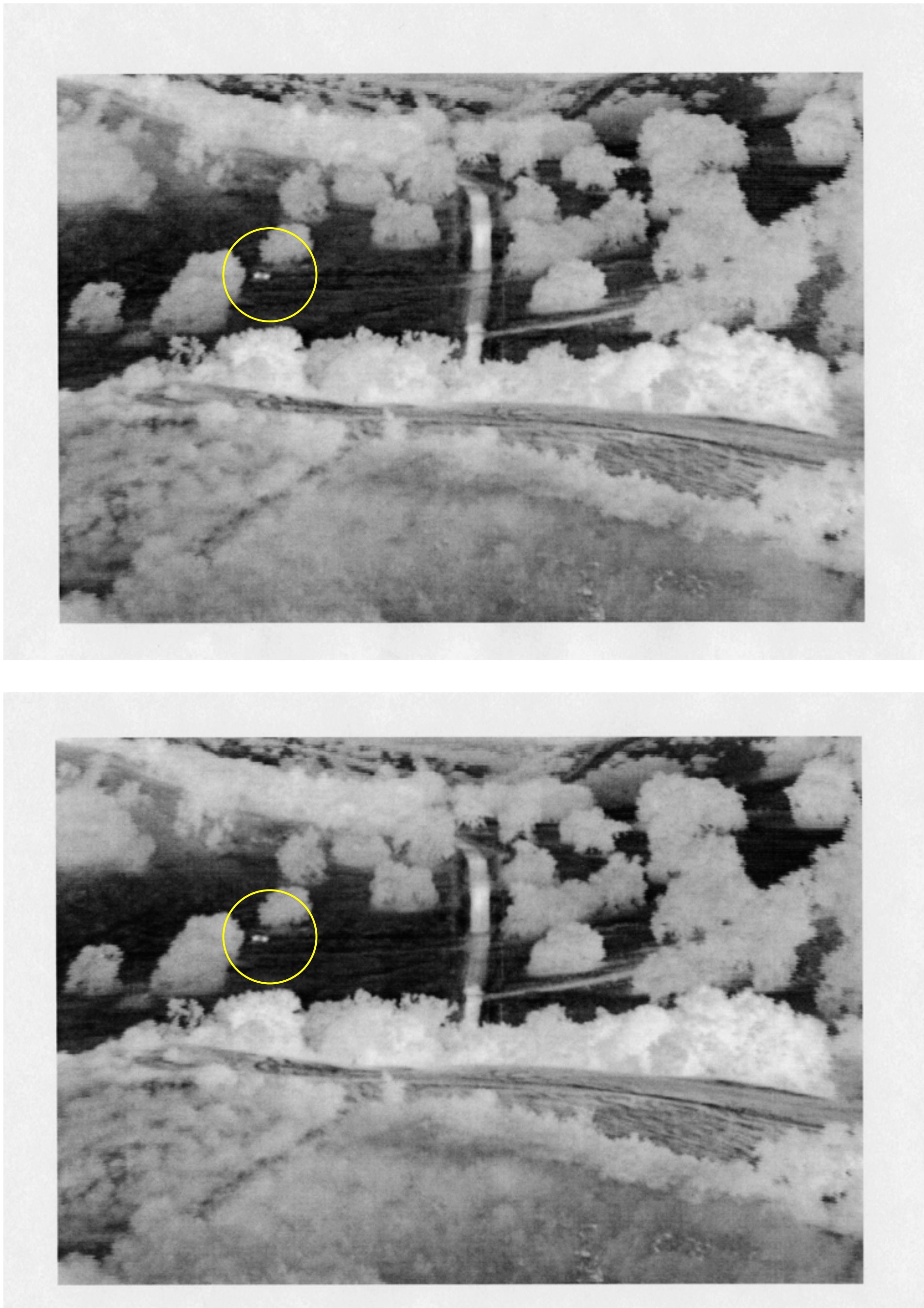

Figure 14. Long Wave FLIR Image of Bare HMMWV, Right/Left side, 1 km

Figure 14 has the depot level camouflaged HMMWV located inside the circle. In general, the HMMWV target is the most difficult to detect of the three targets because it is the smallest target. The vehicle signature is essentially the same on the left and the right side.

Figure 15. Long Wave FLIR Image of Depot Level HMMWV, left/right side, 1 km.

Figure 15 Shows the HMMWV with depot level camouflage as described above. The camouflage further reduces the target signature and makes detection of the stationary vehicle more difficult. It is detectable in the narrow field of view; however, the search time may be considerably longer.

6.0 OBSERVATIONS

These simple low cost camouflage techniques resulted in making the vehicle targets more difficult to detect, through the Long Wave FLIR system using the wide field of view.

The conveyer belt material is rugged and can survive field use.

The conveyer belt material is successful in reducing the infrared signature cues from the tracks, tires and wheel hubs. This type of camouflage may be even more effective in cold and wet weather conditions.

This camouflage is simple to use and easy to install. Its effectiveness is enhanced if the installation crew has a FLIR camera available to verify that the camouflage is hiding all the very hot parts, such as the engine exhaust, engine intake, tracks, road wheels and wheel hubs. On-site personnel reported that the conveyer belt material reduced the sound level of the test vehicles. Sound measurements are planned with and without the conveyer belt camouflage.

Field expedient camouflage with camouflage netting is only effective if the hot spots can be eliminated. The use of pieces of camouflage netting helps in camouflaging the vehicle.

Field expedient and depot level camouflage is within the technological capability of practically any 3rd world country.