



Shade/Color Instrumentation

21 NOVEMBER 2013



TMD, SPIE, PEO Soldier





Instrumentation for Shade/Color Inspection of the OCP Camouflage Fabrics



Objective

This work will be follow on to first generation color imaging system using an off-the-shelf camera system. This work improve upon the first generation by incorporating an advanced digital imaging system supported by software that incorporates improved fitting algorithms

Deliverable

Develop, validate, and implement an imaging system for the color quality control and assessment of Operation Enduring Freedom (OCP) camouflage substrates.

Transition

Transition of color machine testing to replace human eye lot acceptance testing color assessment. FY15

Contractor: NC State University
Contract #: W91CRB-13-C-0049

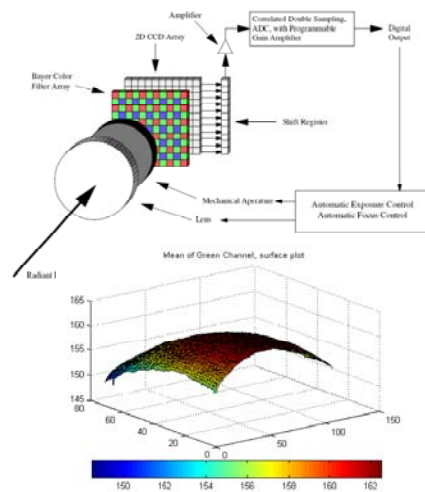
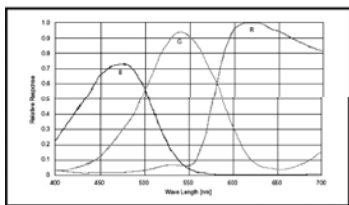
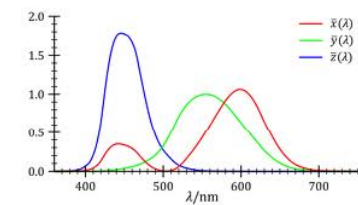
Schedule	Month After Contract Award											
	1	2	3	4	5	6	7	8	9	10	11	12
Hiring Personnel												
Experimental Design												
Testing Experimental Design												
Visual Assessment of Patterns												
Generation of Visual Tolerance												
Assessment of Existing Hardware												
Development of Software												
Measurement of Samples												
Correlation of Visual and Measure Results												
Analysis of Variability												
Assessment of Imaging Methods												
Testing Measurement Protocol												
Verification and Validation												
Data Analysis and Statistics												
Monthly Report												

Rationale

A rapid, accurate, and repeatable digital shade/color assessment technology that enables image processing solutions to analyze shade/color attributes and quality control of OCP camouflage print patterns is needed to provide effective pass/fail or marginal assessments for quality control purposes. This technology can save time and cost by allowing in rapid assessment of quality in military applications.

Contracting:
N/A

 _____ 2





Project Overview

- Objective
 - Instrumentation and standardization for CAMO shade/color inspection
- Technical Approach
 - Hardware design, digital imaging system
 - Software/algorithm/codes development
 - Statistical analysis between visual and instrumental methods
 - Large numbers of samples with visual inspection results → “calibrate” instrument
 - Standards (criteria and tolerance) based on current DoD experts’ visual inspection
- Pay out
 - Eliminating the human subjectivity
 - Minimizing inspection discrepancy among government and industry
 - Reducing government and manufacturers’ risks on cost and schedule
 - Significantly improving the color/shade consistency for better protection
 - Dramatically reducing end item cost



Instrumentation vs. visual

Example: NDTE Machine

2007 SPIE assessment

Improvements



2009 ATEC assessment

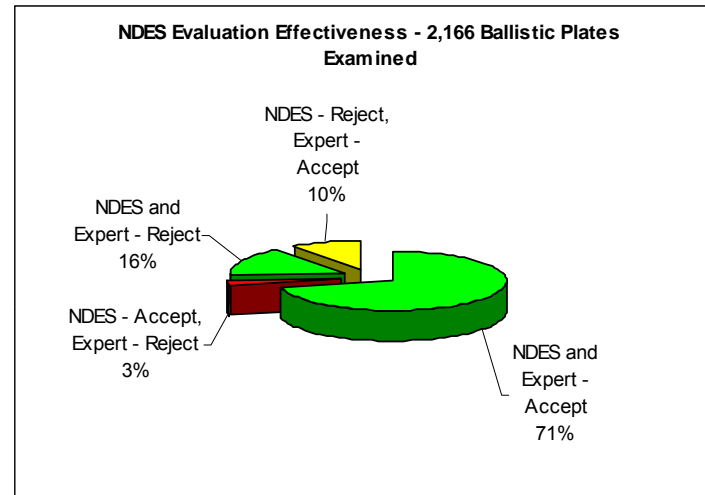


Table 2. NDTE Test Results*

Plate Type	Number of Passes	Number of False Declarations	False Declaration Rate [†]	Success Rate [‡]
Damaged - NRFI**	14140	9 (Accept)	0.00064	0.99936
Undamaged - RFI	96780	195 (Reject)	0.00202	0.99799

Legend:
 * - Source ATC test data Jan09, ** - Damaged test items available (no small-sized ESAPI or ESBI plates available).
 † - False Declarations/Number of Passes, ‡ - 1-(False Declarations/Number of Passes)



Recommendations and Requests

1. Standardize sample size - at least one repeat unit
2. Standardize reference 4 corner points for test sample inspection area
3. Procedures to transfer samples from all First Article and all Lot inspection from DLA-TS to NRSDEC for their "inspection"
4. Procedures to transfer inspection results from DLA to NCSU
5. Procedures to transfer samples and inspection results from NRSDEC to NCSU
6. Need support from government labs, academia and industry