CORRECTING FOR ATTENUATION EFFECTS IN OPTICAL PATTERNATION OF SPRAYS

DEMONSTRATION OF CORRECTION METHODOLOGY DEVELOPED BY
V.G. MCDONELL, ERC & D.G. TALLEY, AFRL

AIR FORCE CONTRACT F04611-97-C-0084

Distribution statement: Approved for public release; distribution unlimited.
MOTIVATION

• "OPTICAL PATTERNATION" OF SPRAYS
  – PLANAR LASER INDUCED FLUORESCENCE APPROACH
  – DISTRIBUTION OF MASS THROUGHOUT SPRAY
  – NON-INTRUSIVE
  – RAPID
  – GAINING ACCEPTANCE AS SPRAY DIAGNOSTIC

• BARRIERS TO QUANTITATIVE RESULTS
  – CAMERA RESPONSE ISSUES
  – ATTENUATION OF EXCITING LIGHT
  – ATTENUATION OF SIGNAL LIGHT
ADDRESSING BARRIERS

- NOVEL METHODOLOGY HAS BEEN DEVELOPED TO SIMULTANEOUSLY ACCOUNT FOR ATTENUATION OF
  - EXCITATION LIGHT
  - SIGNAL LIGHT
DEMONSTRATION STUDY

TWIN-FLUID FAN SPRAY:

- CONTROLLED ATTENUATION EFFECTS
- SYMMETRIC ELLIPTIC DISTRIBUTION
DEMOnstration study

- Top View Orientation

**Attributes:**

0-DEG: Maximum Incident Light Attenuation

90-DEG: Maximum Signal Attenuation

45-DEG: Minimum Incident Light or Signal Attenuation
DEMONSTRATION STUDY

- UNCORRECTED IMAGES

  0 DEG
  0 DEG REV.
  45 DEG
  90 DEG
DEMONSTRATION STUDY

- IMPORTANCE OF CORRECTION: UPPER AND LOWER IMAGES SHOULD BE IDENTICAL BUT ROTATED

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<th>0 DEG</th>
<th>UNCORRECTED</th>
<th>PRESENT FULL CORRECTION</th>
<th>CORRECTION FOR INCIDENT LIGHT ONLY</th>
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DEMOnSTRATION STUDY

- IMPORTANCE OF CORRECTION: LINE PROFILES

UNCORRECTED

PRESENT FULL CORRECTION

0 DEG

90 DEG
DEMONSTRATION STUDY

- IMPORTANCE OF CORRECTION FOR SIGNAL: 90 DEG ORIENTATION

UNCORRECTED  PRESENT FULL CORRECTION  CORRECTION FOR INCIDENT LIGHT ONLY

![Graphs showing intensity vs. Y position before and after correction.](image-url)
DEMONSTRATION STUDY

- COMPARISON OF CORRECTED VOLUME CONCENTRATION TO PDI
CONCLUSIONS

- CORRECTION REQUIRED FOR ACCURATE RESULTS IN SPRAYS WITH SIGNIFICANT OPTICAL THICKNESS
  - INCIDENT LIGHT
  - SIGNAL LIGHT

- METHODOLOGY HAS BEEN DEVELOPED TO ACCOUNT FOR ATTENUATION OF BOTH INCIDENT AND SIGNAL LIGHT

- DEMONSTRATIONS TO DATE HAVE REVEALED GOOD PERFORMANCE
  - 63% "OBSCURATION"
MEMORANDUM FOR PR (Contractor/In-House Publication)

FROM: PROI (TI) (STINFO) 23 Jun 2000

V. McDonel (ERC); D. Talley (AFRL/PRSA), "Correcting for Attenuation Effects in Optical Patternation of Sprays"

10th International Symposium on Applications of Laser Techniques to Fluid (Statement A)
Mechanics (Lisbon, Portugal, 10-13 Jul 00)
8th International Conference on Liquid Atomization and Spray Systems
(Pasadena, CA, 16-20 June 00) (Submission Deadline: 19 Jun 00)

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.
Comments: ____________________________________________
_________________________________________________________________________
_________________________________________________________________________
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Signature ____________________________________________ Date ________________

2. This request has been reviewed by the Public Affairs Office for: a.) appropriateness for public release and/or b) possible higher headquarters review.
Comments: ____________________________________________
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_________________________________________________________________________

Signature ____________________________________________ Date ________________

3. This request has been reviewed by the STINFO for: a.) changes if approved as amended, b.) appropriateness of distribution statement, c.) military/national critical technology, d.) economic sensitivity, e.) parallel review completed if required, and f.) format and completion of meeting clearance form if required
Comments: ____________________________________________
_________________________________________________________________________
_________________________________________________________________________

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4. This request has been reviewed by PR for: a.) technical accuracy, b.) appropriateness for audience, c.) appropriateness of distribution statement, d.) technical sensitivity and economic sensitivity, e.) military/national critical technology, and f.) data rights and patentability
Comments: ____________________________________________
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_________________________________________________________________________

APPROVED/APPROVED AS AMENDED/DISAPPROVED

LESLIE S. PERKINS, Ph.D (Date)
Staff Scientist
Propulsion Directorate