NASA SBIR/STTR Technologies

Simulation Tool for Dielectric Barrier Discharge Plasma Actuators at Atmospheric and Sub-Atmospheric Pressures

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Identification Significance of Innovation

Identification:

✓ Simulation tool for dielectric barrier discharge (DBD) plasma actuator

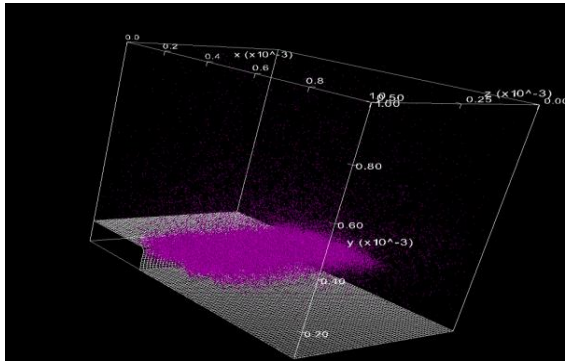
✓ Analyzes and predicts DBD operation at wide range of ambient gas pressures

Significance:

✓ Traditional DBD codes are limited to low-speed applications and have weak prediction capabilities

✓ Proposed tool allows DBD analysis/prediction for subsonic/hypersonic applications

Estimated TRL (1 – 9) at beginning and end of contract: 5-7



3D simulation of the DBD plasma actuator

Technical Objectives

✓*Extend chemical and physical discharge model in VORPAL*

✓*Extend hybrid capabilities of the proposed model*

✓*Enhance computational speed of the proposed DBD Simulation Tool.*

✓*Demonstrate the DBD simulation tool through validation against experimental data at wide range of DBD operational conditions.*

Work Plan

(1) Extend air-chemistry and collision database for DBD plasma actuator modeling

(2) Implement photoionization model in VORPAL

(3) Enhance hybrid capabilities of the DBD Simulation Tool

(4) Integrate multilevel mesh concept into DBD Simulation Tool

(5) Develop the concept of adaptive timesteps for multilevel meshes

(6) Implement the electric circuit model into VORPAL

(7) Perform experimental study of the DBD plasma actuator at wide range of ambient gas pressures

(8) Validation and verification of the proposed DBD simulation tool

NASA Applications

✓ Active flow separation control at turbine blade

✓ Active flow separation control at fixed and rotary wing aircrafts

✓ Active flow control at hypersonic vehicles

Non-NASA Applications

✓ Subsonic/hypersonic program of major aerospace companies

✓ Flow separation control at commercial airplanes and tiltrotor aircrafts

✓ Plasma-aerodynamics

✓ Plasma medicine

✓ Plasma-processing

Firm Contacts

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NON-PROPRIETARY DATA