

Micro Adaptive Flow Control

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DARPA Tech 99



MAFC

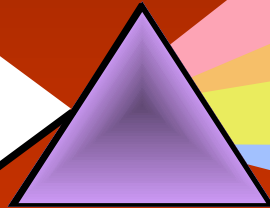
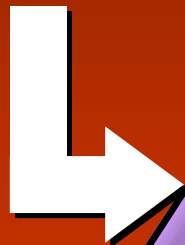
MICRO

**Controlling large scale flow behavior
using small scale/low energy
actuation**

ADAPTIVE

FLOW

CONTROL



**ENABLES A
SPECTRUM OF
MILITARY
APPLICATIONS**



Aircraft



Engines



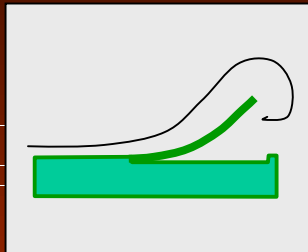
Munitions



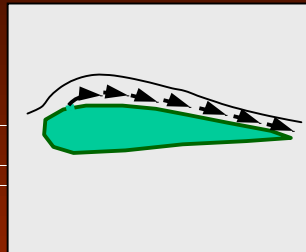
Maritime



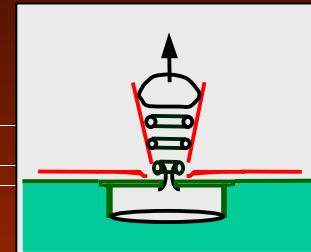
Enabling Generic Actuator Concepts



MEMS/Smart Materials



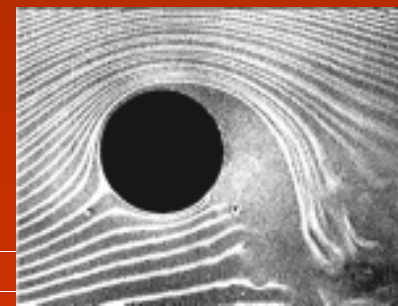
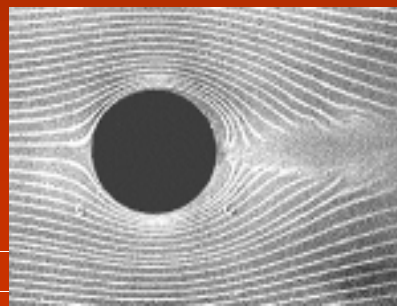
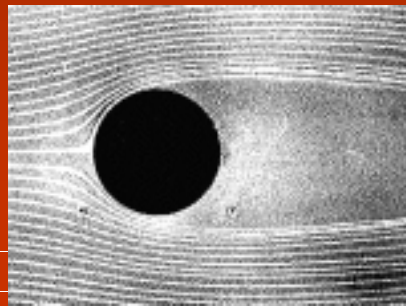
Pulsed Blowing



Synthetic Jet

Flow Around a Cylinder

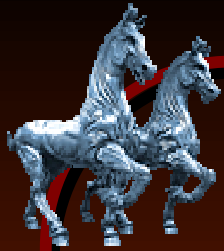
Synthetic Jet Closes Wake, Eliminates Form Drag, Controls Circulation





Program Goals

- Demonstrate large scale flow control with small actuators
- Demonstrate robust control under real flow conditions
- Achieve radical performance enhancements with MAFC



Program Strategy

- Identify System Level Application
- Develop MAFC Concept
- Design and develop actuators and controllers
- Validate MAFC performance
- Integrate and demonstrate system



Current Status

- Phase II Tech. Development & Feasibility Demonstrations
 - Radical propulsion system performance
 - Aerodynamic tailoring for flight controls and performance
 - Precision munitions trajectory control



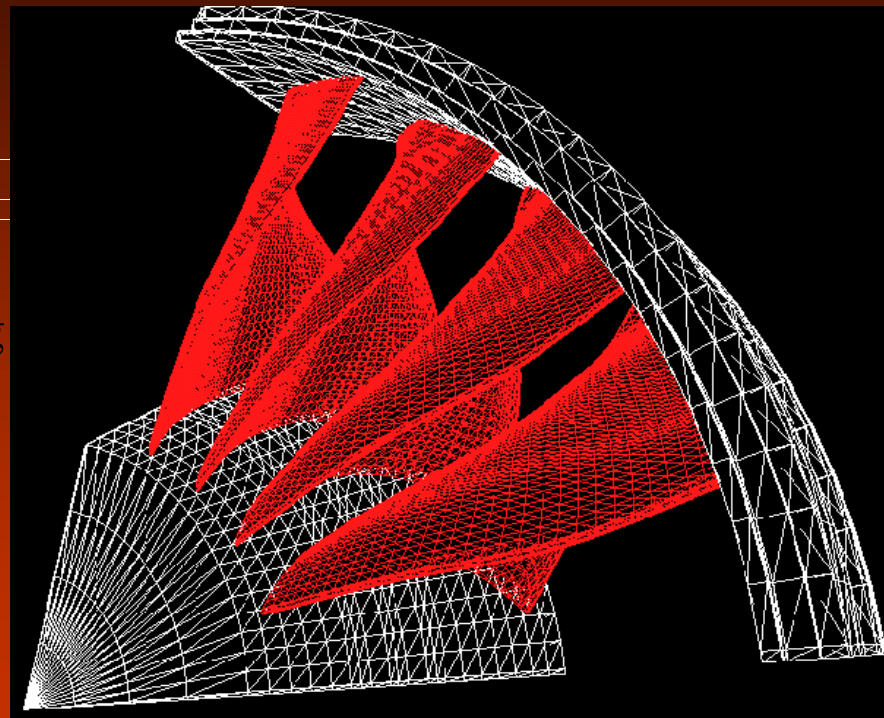
Aspirated Compressor



Conventional Rotor Blading
3 Stages



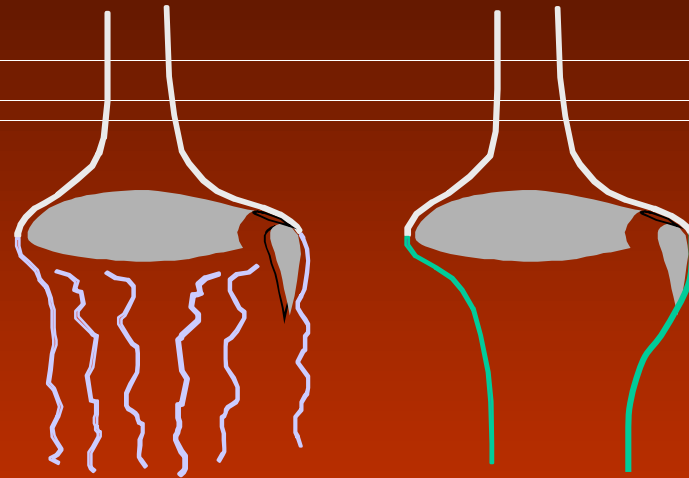
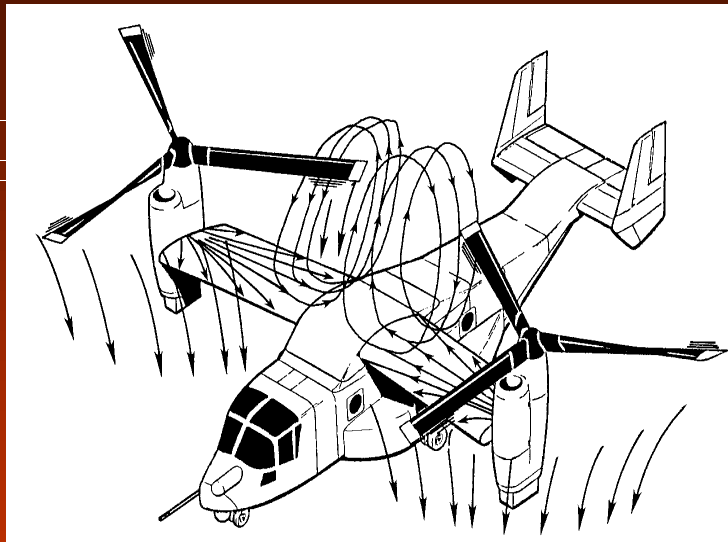
Aspirated Rotor Blading
1 Stage



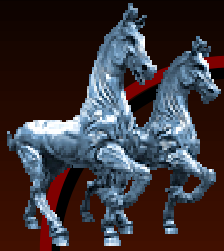
Aspirated Rotor with Tip Shroud
Pressure Ratio = 3.8



V-22 Lift Enhancement

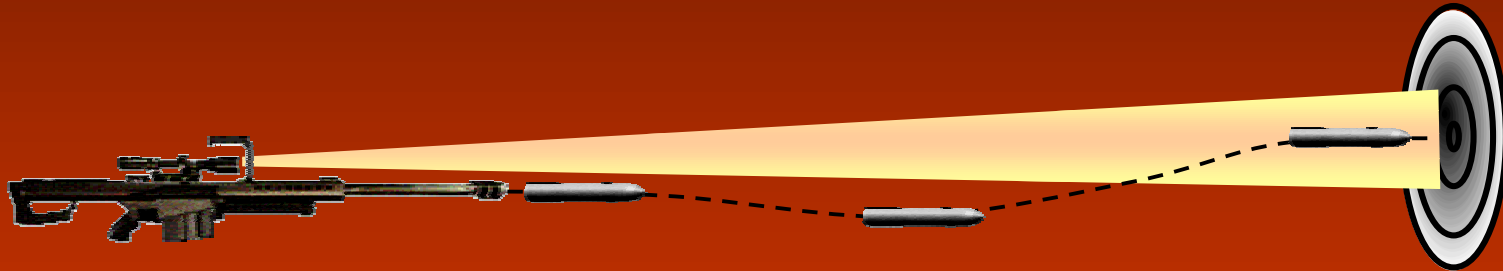


Close wake with flow control on flaps to reduce downwash and increase V-22 lifting capacity **30%**



Munitions

- Lutronix - Range Extended Adaptive Munition



Fins steer 50 cal munition to reduce wind drift and ballistic drop for increased accuracy at longer ranges



Future

- Planning BAA for Fall 1999
- Develop and demonstrate technical feasibility of MAFC concept
 - System level realizability
 - System level demonstration of radical performance
- Munitions, Maritime, Aerodynamics, Engines
- DARPA is interested in hearing from the community as to potential applications and approaches.