**Various Applications of Flow Control**

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### Active Control of Structural Vibrations and Aerodynamic Performance of Wind Turbine Blades – Funded by NYSERDA

**Victor Malnudkin, Bill Grossick, and Miki Amitay**

#### Wind Energy
- As wind turbines increase in size and power, they become more prone to high amplitude fatigue loads that reduce the operating life of the wind turbine.
- Wind turbines suffer from low energy production at low wind speeds and must be shut down at high speeds to avoid structural damage.

#### Objectives
- Reduce blade vibration by selectively increasing or decreasing the aerodynamic loads along its span using active flow control via synthetic jet actuators.
- Increase the efficiency of wind turbines by improving their energy capture capability at low wind speeds and relieving unwanted loads at high speeds.

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### Synthetic Jet Actuators


- Zero-net-mass-flux (ZNMF)
- Allows maximum transfer to the flow
- Diaphragms and cavities are driven near resonance
- Small electric power input
- No plumbing or any mechanical complexity is needed
- Low cost

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### Active Control of transonic flow in serpentine inlets – Funded by Northrop Grumman Corporation

**John Vaccaro and Miki Amitay**

- The inlet to an aircraft propulsion system must supply flow to the compressor with minimal pressure loss, distortion, or unsteadiness. Otherwise, the overall system performance will be reduced.
- For many military applications, the inlet design is also constrained by low observability requirements. To reduce the radar signature from the compressor face, a serpentine inlet is typically used to block line-of-sight.
- This can result in flow separation inside the inlet. Therefore, technologies such as active flow control that can enable more aggressive inlets can have a significant overall system benefit.

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### Propulsor Thrust Vectoring through Stator-Induced Circumferentially-Varying Preswirl - Funded by ONR

**John Farnsworth and Miki Amitay**

- Investigate a methodology of active flow control (via addition of swirl) to provide und cascade vehicles with additional maneuvering and control while reducing noise.
- Potential applications: UUV’s, Recovery, Synthetic Aperture Sonar, Torpedoes

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### SOMS Hybrid Spin-On Filter – Funded by SOMS Technologies (through NYSERDA)

**Steve London and Miki Amitay**

- Hybrid spin-on filter designed for use standard in automobile engines
- Simple design replaces conventional oil filter with no modifications to engine or installation
- Up to 25,000 miles between oil changes

#### Objectives
- Conduct in vivo testing of the filter to understand the physics of the oil/particles flow field, particles distributions, etc. for “realistic” engine operation.
- Hybrid spin-on filter designed for use standard in automobile engines

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### SOMS Hybrid Spin-On Filter

**Steve London and Miki Amitay**

- State of the art optical measurement techniques (PIV and PTV) are implemented using clear silicone oil and SAE 5W-30 test dust
- Particle concentrations and flow fields after passing through micro-filter will be calculated.
- Hydraulic pump simulates engine conditions, including periods of acceleration and deceleration.

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### Active Control of transonic flow in serpentine inlets

**John Vaccaro and Miki Amitay**

**Fully Assembled Inlet Facility**

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### Micro Flying “Bagel” – Funded by CATS

**Bill Grossick and Miki Amitay**

- MAVs are limited to 6”×6”×6” and a gross takeoff weight of 100gr.

#### Active Flow Control
- Flight control is achieved by active control of the flow over the stators.
- Two 20mm 3Hz piezo-discs are installed in each stator (0.2W each).

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### SOMS Hybrid Spin-On Filter

**Steve London and Miki Amitay**

- Benefits of Hybrid Filter Technology
  - The hybrid spin-on filter improves filtration efficiency leading to the absence of small particles in the engine oil.
  - It prolongs oil filter and engine life and can reduce maintenance and operating costs.
  - It reduces friction, which increases engine and fuel efficiency.
  - Due to the high filtration efficiency (in excess of 25,000 miles), the filter can be used to extend oil and filter change intervals.
  - Extended oil drains provide direct and indirect savings.