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1. Simulation of Biomagnetic Fluid around Semicircular Thrombus

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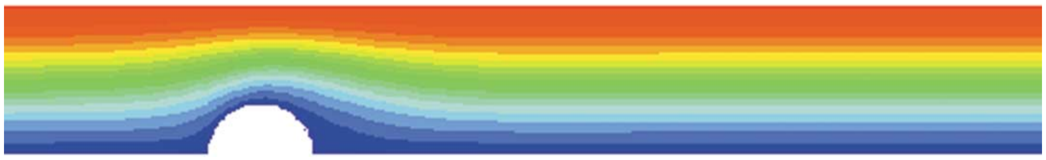
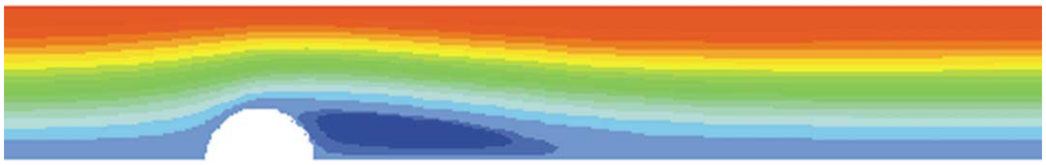
1. B=0 tesla, Re=10



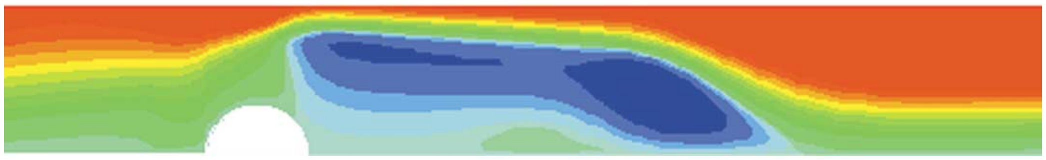
2. B=1.3 tesla, Re=10

3. B=1.7 tesla, Re=10

4. B=0 tesla, Re=100



5. B=1.3 tesla, Re=100



The figures above show simulation of a biomagnetic fluid subjected to a magnetic field that is generated by two magnets; one magnet is located at the front edge of the semicircular thrombus while the other is directly adjacent to it and under the thrombus. The south pole of the first magnet is facing the thrombus while the north pole of the second magnet is facing the thrombus. The simulation is obtained by solving a modified Navier-Stocks' equations to accommodate for the magnetic force. As it is clear from the figures the placement of a magnetic field under the thrombus enhances the fluid circulation and thus increases the fluid friction. Also, as the magnetic field increases the circulation zones increase. This is because of the interaction between the inertia forces and the magnetic force of the biomagnetic fluid. The magnetic force is attracting the fluid toward the maximum field (near the thrombus) while the inertia force is pushing the fluid away from the thrombus.

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2. Shock/vortex Ring Interaction and the Generation of Acoustic Waves (1)

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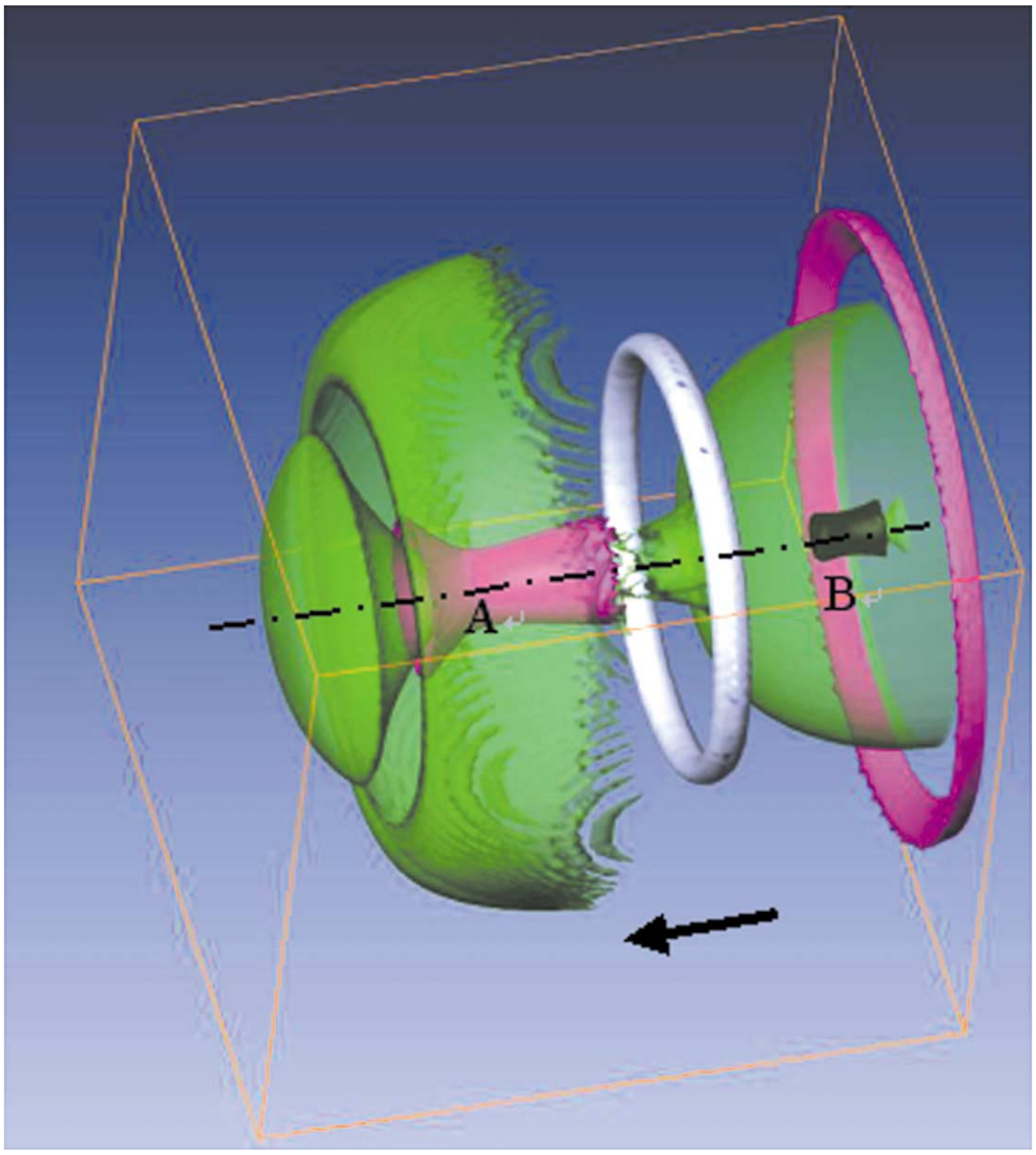

Simulation result for the pressure field due to the passage of a vortex ring (R=50, Γ=0.01) through a stationary Mach 1.5 shock at t=39.0 is shown. The interaction results in a toroidal acoustic wave, which at large times, self-interacts on its symmetry axis at the two points A and B and generates high amplitude pressure disturbances. The pressure disturbance is a compression at A and a rarefaction at B. The shock is located on the right and the mean flow is from right to left. Pink color represents compression, green and black colors represent rarefaction. The outer contour of the vortex ring (based on the velocity magnitude) is also shown (in white color).

3. Shock/vortex Ring Interaction and the Generation of Acoustic Waves (2)

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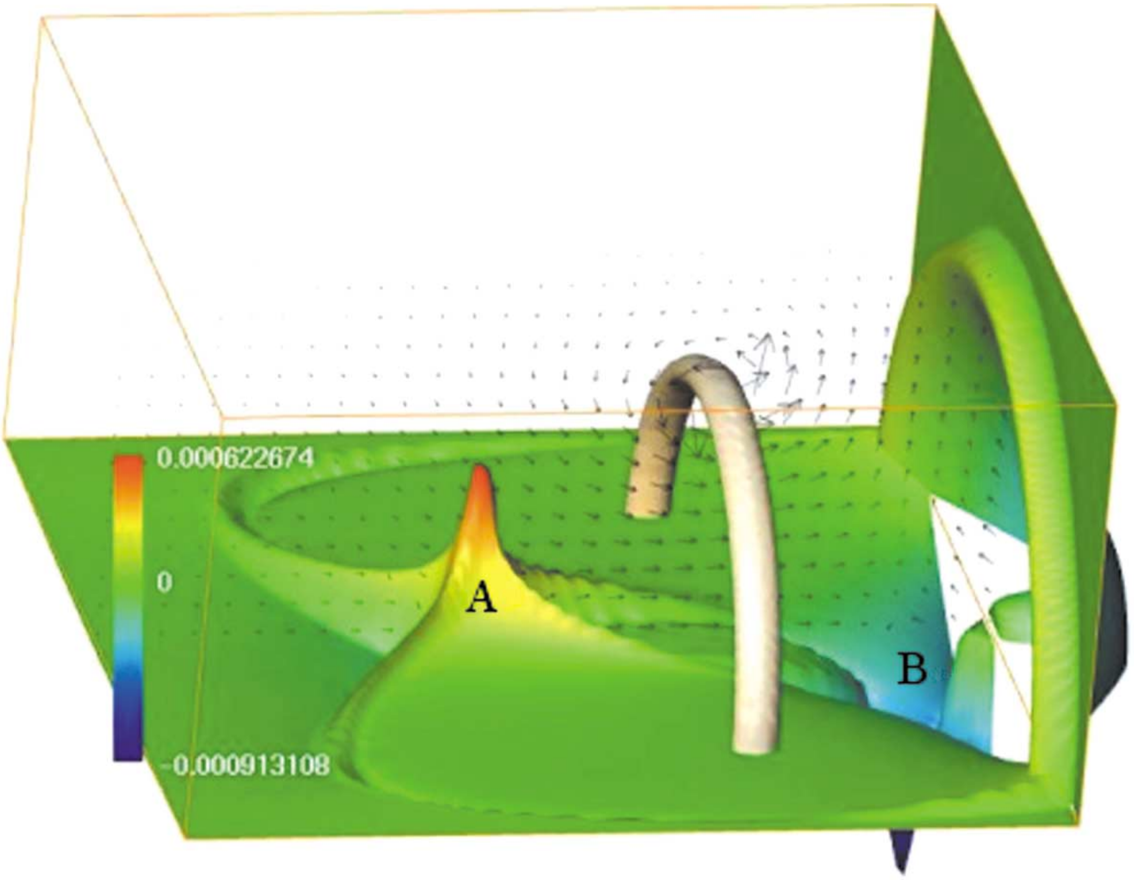

Simulation result for the pressure field due to the passage of a vortex ring (R=50, Γ=0.01) through a stationary Mach 1.5 shock at t=39.0 is shown. The plot shows the isopressure contour on the horizontal plane (through the symmetry axis) and on the shock front (vertical plane). The pressure disturbance is a compression at A and a rarefaction at B. The outer contour of the vortex ring (based on the velocity magnitude) and the velocity vector field in the vertical plane are also shown.

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4. Vortex-shedding in a Transonic Compressor

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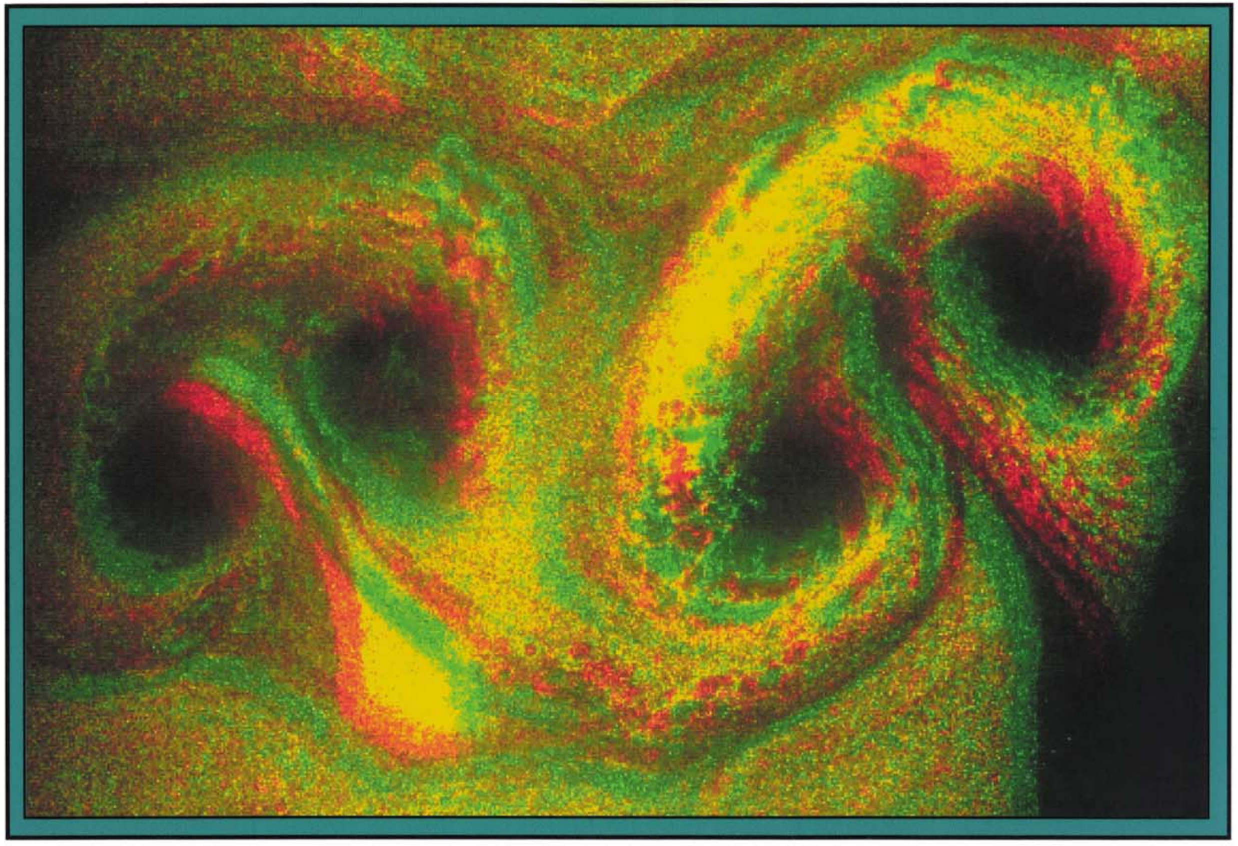

Vortices from the wake in a high-through-flow, axial-flow transonic compressor located in the Compressor Aerodynamic Research Laboratory (CARL) at Wright-Patterson Air Force Base were visualized using Digital Particle Image Velocimetry (DPIV). These vortices are shed from the wake generators (WGs) and driven by the potential field of the blade. The axial distance between the WG and the blade leading edge is 56% of the chord at 50% of the WG span. The visualization was performed using a cross-correlation camera, with a double exposure of 1 μs. The first frame was colored green and the second, red. The images were superimposed, resulting in the orange DPIV visualization.

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5. Smoke-wire Flow Visualization of the Dynamic Stall Vortex over the Basic Wing-body Model in Pitching Motion*

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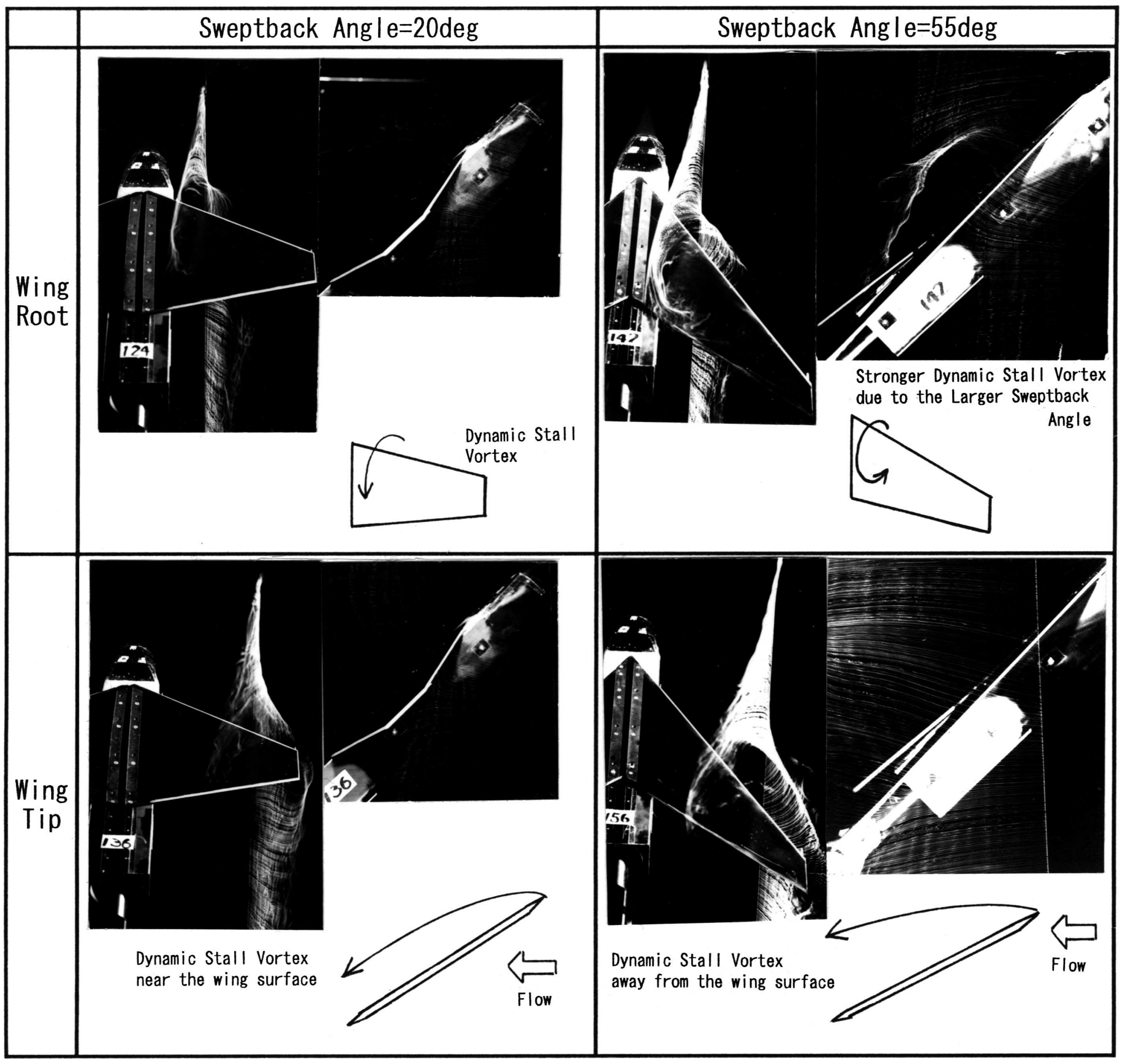

Dynamic stall vortices formed over the basic wing-body model in pitching motion were visualized by the smoke-wire technique. The pictures were captured at the moment the model was at 40 deg angle of attack during the pitching-up motion from – 20 deg to 60 deg angle of attack. The uniform flow velocity was 10 m/s and the reduced pitch rate k=0.025. The leading edge sweptback angle was found to be of great effect on the strength and the location of the dynamic stall vortex, which results in the difference in the lift increment during the pitch-up motion measured by the internal balance.

* Hirano, H., Shimbo, Y., Ishiguro, M. and Taniguchi, M., Dynamic Lift Wind Tunnel Test of a 3-D Basic Configuration Model (Aerodynamic Force Measurement and Flow Visualization), Journal of Aeronautical and Space Science Japan, 48-561 (2000), 567-572

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6. Oil Flow Pattern Visualization on a Space Plane of Supersonic Speed by Wind Tunnel Experiment and Computational Fluid Dynamics

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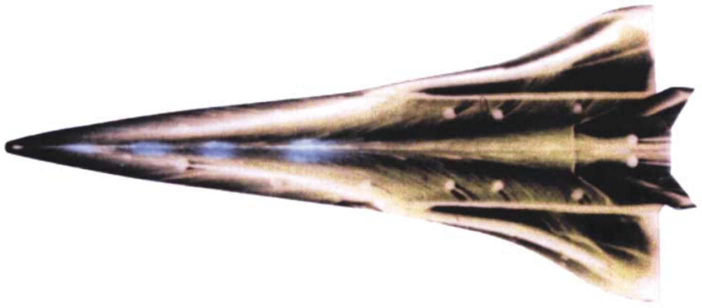

EXPERIMENT

COMPUTATION

OIL FLOW PATTERNS
M=1.5 $\alpha = 15°$

The results of a wind-tunnel experiment and a computational simulation are compared. The flow speed about a Space Plane is Mach 1.5 while the angle of attack is 15 degrees. The Reynolds number is 4 million regarding the half-span of the wing as a normalizing length. This Space Plane Model has been under research at the National Aerospace Laboratory (NAL) in Japan.

The upper picture shows the result experimented and visualized at the NAL using its supersonic wind tunnel.* The lower one presents the computational visualization of the numerical results simulated using the high performance computer system called Numerical Wind Tunnel (NWT) at the NAL.**

* S. Sakakibara, T. Hara, J. Noda, H. Sekine, K. Ishida, S. Nomura and T. Uchida, Pressure distribution measurement at NAL's supersonic wind tunnel about a Space Plane, Proceedings of the 26th Aircraft Symposium, 1988, pp. 648-651. (in Japanese)

** K. Matsushima and T. Iwamiya, Practical Application of CFD to High Angle of Attack Aerodynamics, Journal of Japan Society of Aeronautical and Space Sciences, 48-561, 2000, pp. 554-559. (in Japanese)