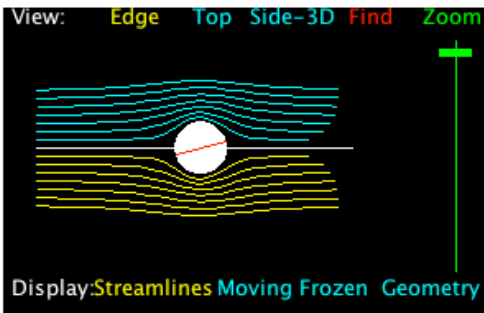
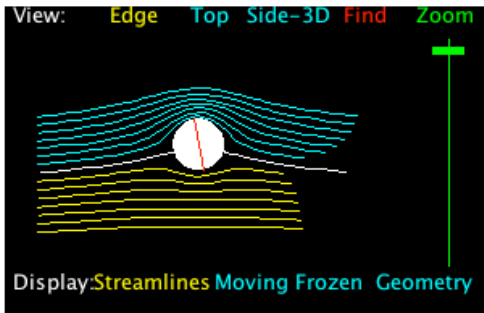


1 m dia cylinder, 40 km/

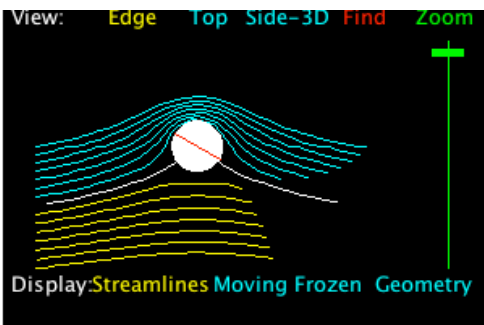
0 RPM Simple Bluff Body



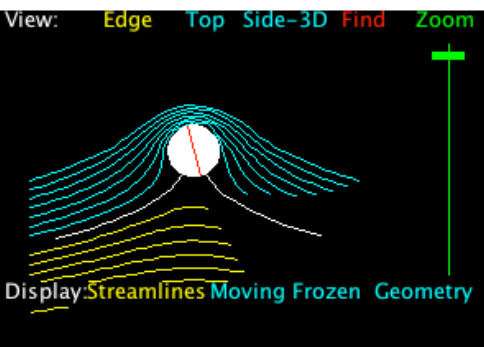
20 RPM TSR .09



40 RPM TSR .18

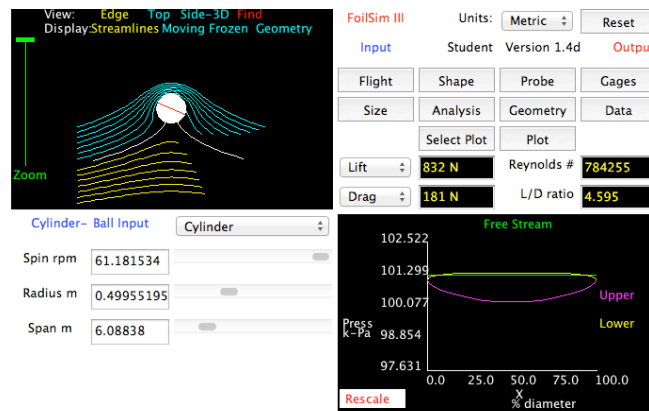


60 RPM TSR .28



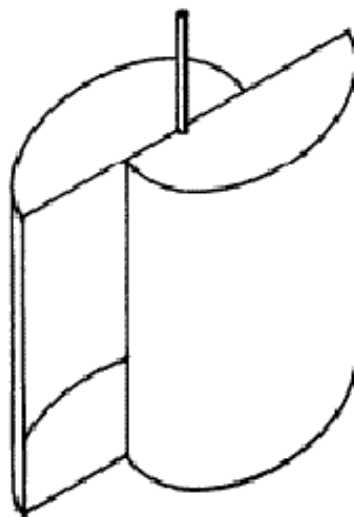
These images are captured from the NASA foilsim program. They show the flow pattern around a Flettner rotor, which has also been called a Roto Sail by Jacques Cousteau.

A Flettner rotor works like an airfoil, using the Magnus effect to create lift on one side of the cylinder, roughly perpendicular to the flow. It does require energy to spin the rotor, but the lift produced is much greater than the drag. In the instance shown below, it has an L/D ratio of 4.5. It takes remarkably little energy to power these rotors, and in a way, they act analogously to heat pumps, put a small amount shaft power in and the turbine produces substantial lift.



..As a historical note of relevance, the Savonius Rotor, on which the ART Turbine is in part based was invented by Captan Savonius, who was looking to create a Flettner rotor that wouldn't need power. He was looking for and

found an alternative to sails which the steam engine soon provided, albeit not nearly as efficiently but with much greater convenience and control.



The ART Turbine also produces this flettner effect, though it rotates at much higher speeds ($TSR < 1.5$). It is interesting to note that the TSR at which the Flettner rotor produces the maximum L/D, around .28, is also the TSR at which the Savonius Rotor produces its maximum C_p , which is around 4-5%. I don't know that anyone has ever tried to determine

the L/D ratio of the Savonius Rotor.

One of the most significant questions this flow model raises for me, is does this relate to the Betz Limit, which largely seems to be based on straight through flow? In the case of a Flettner Rotor, or an ART Turbine acting like a Flettner rotor, the turbine seems viscously coupled to and interacting with 3-4 times more air than its sectional area, from the foilsim data.