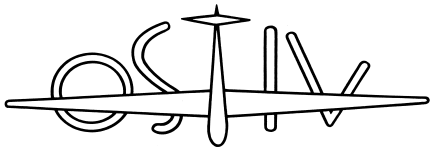

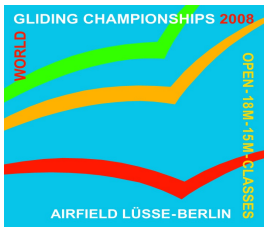

OSTIV Congress, Sunday, 10 August 2008

After a "rest day" for OSTIV, the first paper of the third day of lectures was "Fatigue of Composite Scarf Joints," given by the OSTIV Vice-President, Christoph Kensche. Although the first part of the research presented was directed toward wind-turbine blades, the 70-m blades have much in common with glider wings. A fatigue investigation was conducted on specimens having a number of different scarf-joint repair configurations. In the cases tested, all having different scarf slopes, the repaired structures never achieved the same fatigue resistance as the original specimen unless additional layers of material were added. It was noted however, that these scarf-joint repairs may not have been done in the same manner as is common practice in sailplane repairs. The presentation then continued with the reporting of a research effort having the goal of trying to reduce the time required to determine the certified service life of carbon-fibre reinforced plastic (CFRP) general aviation aircraft. This was done by subjecting CFRP spars with scarf joint repairs to fatigue tests. With a proper repair, a relatively short duration fatigue test results in no degradation in fatigue resistance; however, it does result in a lowering of the stiffness. It is proposed to use the stiffness reduction obtained from a short duration fatigue test as a means to extrapolate the results to predict the number of cycles required for failure, thereby greatly reducing the time and effort required to determine the service life of CFRP aircraft.

The next lecture, given by Jakob Lenz, was entitled, "Range minimization by saw-tooth mode optimization for motor gliders with retractable engines." The goal of this research is to determine for motor gliders having retractable engines the minimum use of fuel per kilometer flown. An optimal control problem was formulated that considered a motor glider having the engine/propeller either fully extended and operating or retracted, with the time for extension and retraction fixed at 15 seconds each. As expected, the optimal profile is accomplished with climb at maximum power and flight at the lift coefficient corresponding to maximum climb, followed by engine retraction and glide at the maximum lift-to-drag ratio. An optimal altitude interval was determined to be, for the glider considered, 684 meters, and having a cycle length of 1261 seconds; however, the overall performance was relatively insensitive to changes in the altitude interval.

After the break, Jakob Lenz presented another talk, "Unique flight performance capabilities of solar-powered airplanes." To begin this presentation, a brief history was given, followed by a discussion of the unique design requirements that must be taken into account for a successful solar-powered aircraft. The paper then covered the development of a solar-powered airplane, the Solar Impulse, being designed at the

Technical University of Munich. This very challenging problem was formulated as an optimal control problem to determine the optimum altitude profile, as well as the corresponding performance parameters, for such an aircraft to fly continuously, that is, with unlimited endurance.

Jakob Lenz also gave the final lecture of the day, “Why birds and model gliders can fly without a vertical tail.” This interesting presentation explored the static and dynamic stability and control issues of birds and mini-airplanes that allow them to have stability without a vertical tail. It is found that the relationship of the mass properties to the length scales of these small aircraft and birds allow them to have sufficient stability without a vertical tail and sufficient control authority in yaw without a rudder. In particular, if the aircraft is small enough, wing sweep alone is able to provide sufficient yaw stability. Likewise, aerodynamic modeling shows that if the aircraft is again small enough, the wing alone is able to generate a sufficient amount of yaw damping, for which a larger aircraft normally requires a vertical tail. Finally, because of the magnitudes and signs of the yawing generated by rolling, a rudder is not needed.

After this presentation, we took the afternoon off in order to enjoy the air show ongoing at the contest site.