Hyperion, the Hybrid Propulsion BWB-UAS

The Hyperion project at the University of Colorado (CU) is to conceive, design, integrate, and operate a 3 meter wingspan and 1.25 meter max chord flying wing airframe with a unique patent pending parallel hybrid propulsion system. The Hyperion aircraft serves as a test-bed for research and development in the following focus areas: aerodynamics, structures and materials, weights and mass properties, handling and control, flight mechanics, and efficiency improvements on performance. Specifically the research effort is investigating numerous technologies aimed at reducing emissions and augmenting operational capabilities of air vehicles. Research findings benefit next generation "green" passenger and transport aircraft as well as smaller unmanned aerial systems (UAS). In fact, the actual Hyperion aircraft designed is of similar size as several current operational UAS and thus lessons learned have firsthand applications to class 1 UAS.

The geometric shape of the flying wing aircraft provides aerodynamic advantages compared to traditional tube and wing configuration which reduces the amount of power required for flight. The body has an S5016 airfoil shape and the wings are S5010 airfoils. Wing endings are raked wing tips and the rudders are integrated in the H-tail. This design predicts a better damping of the Dutch roll eigenmode, the flight mechanics are less complex and the structural loads are reduced. In addition, almost all of the airframe is made out of composites, resulting in a 20 lb. airframe with 20 lb. payload capacity. The reduction in weight from composite use reduces the power required, thus reducing emissions even further while increasing endurance.

The hybrid power plant for the Hyperion aircraft is also designed at the University of Colorado. This parallel gas-electric engine was originally developed by a previous design team at CU and is now licensed by TIGON EnerTec, Inc (www.tigonenertec.com). The first successful flight test (on a specially designed airframe) of the first generation hybrid dual torque engine, called HELIOS, was achieved in April 2010. The unique system seamlessly blends power from an internal combustion engine and an electric motor to a single propeller shaft. The hybrid technology allows for a reduction in fuel burn over conventional gas burning engines as well as provides the user with the capability of switching and blending between the two power sources. Switching to the electric-only mode greatly reduces the acoustic and infrared signature of the vehicle which is advantageous when flying covert missions or around populated areas. The hybrid solution provides a combination of endurance and acoustic quietness, including high reliability, which cannot be provided by current purely electric UAS. The dual engine may also eliminate catastrophic consequences of a single engine failure and provides an opportunity for safe landing or

return of data and payloads. The modularity of the hybrid solution also allows for optimization of payload volume and mass with respect to the concept of operation. Engine and payload are modular assemblies for a specific, well defined mission, in contrast to “one vehicle for all missions.” Mission duration is very flexible: the engine system can be quickly and easily configured for multiple missions of different duration. The ICE may also run on diesel and biodiesel. Operation can also be adjusted to local fuel and energy availability which eases any bottleneck in supply. For higher powered applications the ICE could be replaced by a turbine.

The Hyperion project is also dedicated to the aerospace workforce development. The design team of 33 graduate and senior undergraduate students guided by five faculty members is composed of four international groups, two at the University of Colorado (CU), one at the University of Stuttgart, Germany, and one at the University of Sydney, Australia. In addition to the design of the airframe and engine, manufacturing is taking place across international borders as well. The students learn critical skills that are desired by global aerospace companies with delocalized operations.

Final assembly of the Hyperion vehicle will occur in Boulder, Colorado, in March-April, with test flights scheduled for summer. The Hyperion aircraft will be showcased at the University of Colorado on April 15 during the Aerospace Engineering Department’s Design Symposium. Details on the Symposium can be found at http://aeroprojects.colorado.edu.