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Challenges for Hypersonic Business Transportation

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The business world of today is faster and faster, and supersonic research programs for commercial aviation are considered/proposed, e.g. the EU funded LAPCAT or the Quiet Supersonic Platform (QSP) program sponsored by DARPA. It is clear that today the technology exists to solve the main issues of supersonic flight. For example, it is well known that properly shaping the fuselage and other aerodynamic elements reduces the sonic boom and furthermore that the smaller the airplane, the smaller the sonic boom it will create.

In order to meet the prospected needs of the coming decades, a medium range near hypersonic transportation system based on relatively small airplanes appears of strong interest to cover transoceanic and intercontinental routes in a fraction of the time it takes today.

New generation hypersonic planes may offer a very important step towards the development of future aviation transportation systems and/or extensive access to space, combining efficiency and advanced technologies with emerging markets and with high traffic levels, not neglecting green challenges. The result will be airline operations for fast long-range business transport, taxi services or very fast intercontinental special cargo transportation. In this perspective, small hypersonic planes may also offer a very important opportunity for transportation of specific products, e.g. pharma, valuables live, perishable, that represent a relatively small percentage of the total today cargo products but have special requirements. An example is organ transportation over transcontinental a distance that is impossible today (Figure 1).

Previous supersonic or hypersonic commercial designs include large aircrafts, characterized by hundreds of tons of mass and hundreds of passengers. This resulted in great difficulty to develop a valid and sustainable operational concept, because of very large costs, reduced market and problems related to the environmental impact (sonic boom and emissions in the stratosphere). In addition, the system concepts were often very complex, requiring very long time to reach the required technology readiness level. In fact the supersonic transport is for the moment a market failure, casting doubt on the hypersonic transportation. It must be underlined that some studies are still going on in this direction!

Figure 1: Long-term vision for future access-to-space and hypersonic transportation.

In order to keep weights and costs down, a small passenger hypersonic plane of the size of an executive jet may take advantage of previous experiences in the general aviation and represent a first step towards development of larger complex systems, opening new markets and applications. For instance, such an aircraft could be proposed for the "urgent travel" market segment, offering at the very same time the opportunity to perform flight experimental test and demonstrations on new technologies in the fields of high speed air-breathing propulsion, aerodynamics, materials and structures, etc.

The mid-to-long term perspectives of point-to-point hypersonic flight are based on the availability of winged vehicle configurations, characterized by low wing loading and able to manoeuvre along the flight trajectory at small angles of attack. These airplanes will fly at very high altitudes in the stratosphere in order to reduce drag and to fly faster across intercontinental distances (Figures 2 and 3).

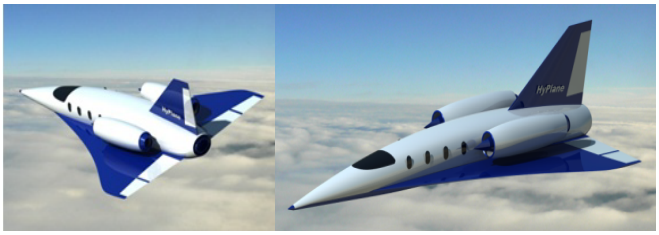

Figure 2: Low wing loading aerodynamic configuration.

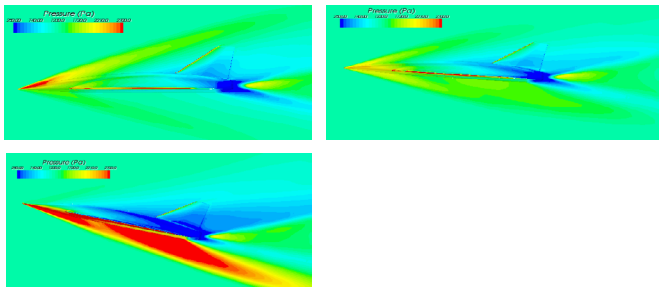

Figure 3: CFD computations of pressure field around the airplane at different angles of attack.

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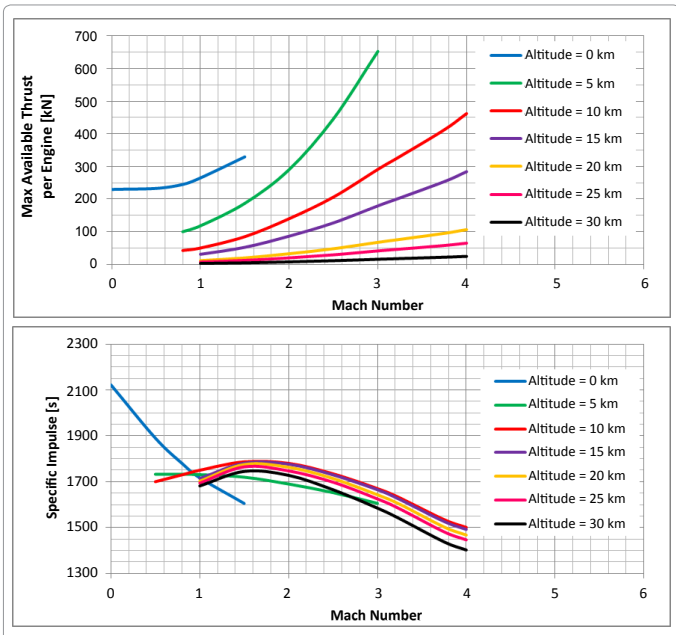

Figure 4: Predicted performances of turbo-ramjet engine.

Figure 5: Hyplane Rendering.

A properly designed propulsion system, able to provide a sufficient thrust at high speeds and altitudes with a limited fuel consumption, has also to be developed. Only air-breathing engines (i.e. ramjet) may guarantee low fuel consumption (Figure 4).

Furthermore, in order to promote a commercial use of such kind of transportation, accelerations and load factors must be of the same order of those characterizing the present civil aviation aircraft (FAA/EASA standards).

A six-passenger HyPlane high-supersonic/hypersonic airplane has been proposed in previous national [1] and international [2] congresses.

The high level specifications for this system may be a cruise Mach number of 4-6, accommodation for 6-10 passengers, a range of approximately 5000-6000 km, horizontal take-off, aero-assisted climb phase and high cruise altitude (around 30 km), hypersonic flight with efficient air-breathing propulsion systems, gliding descent and traditional horizontal landing capabilities [3] (Figure 5).

It is our opinion that, when aviation relatively soon will evolve towards very high speed systems, they will guarantee much better opportunities for fast transportation not only using world hubs, but also smaller new generation airports. Meanwhile, Space Tourism will spread all over the world guaranteeing much cheaper ticket costs than 200 k€/pers. offered today.

A proper mix of available technologies, from aeronautical and space sectors can make technically feasible to design and realize a small hypersonic vehicle able to take-off and land horizontally within the present set of rules governing common airports. In this scenario, new hypersonic aircraft designers and manufacturers will emerge as well as new airline companies offering new capabilities, complementing larger civil transport aircrafts for the above mentioned market segments, in particular urgent business travel and space tourism.

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