Novel Distributed Air-Breathing Plasma Jet Propulsion Concept for All-Electric High-Altitude Flying Wings

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Résumé

The paper describes a novel distributed air-breathing plasma jet propulsion concept for all-electric hybrid flying wings capable of reaching altitudes of 100,000 ft and subsonic speeds of 500 mph, Fig. 1. The new concept is based on the recently achieved first breakthrough for air-breathing high-thrust plasma jet engines [5]. Pulse operation with a few hundred Hertz will soon enable thrust levels of up to 5-10 N from each of the small trailing edge plasma thruster cells with one inch of core engine diameter and thrust-to-area ratios of modern fuel-powered jet engines.
An array of tens of thrusters with a magnetohydrodynamic (MHD) fast jet core and low speed electrohydrodynamic (EHD) fan engine based on sliding discharges on new ultra-lightweight structures will serve as a distributed plasma "rocket" booster for a short duration fast climb from 50,000 ft to stratospheric altitudes up to 100,000 ft, Fig. 2. Two electric aircraft engines with each 110 lb (50 kg) weight and 260 kW of power as recently developed by Siemens will make the main propulsion for take-off and landing and climb up to 50,000 ft [3], [4]. Especially for climbing up to 100,000 ft the propellers will apply sophisticated pulsed plasma separation flow control methods. The novel distributed air-breathing plasma engine will be only powered for a short duration to reach stratospheric altitudes with lowest possible power consumption from the high-density battery swap modules and special fuel cell systems with minimum 660 kW, all system optimized for a short one to two hours near-space tourism flight application [2].

The shining Plasma Stingray shown in Fig. 1 can bring up to six space tourists to the edge of near-space in less than an hour, switch-off the plasma pulse detonation engine at 100,000 ft and come back as a glider or lifting body aerospace shuttle. Advanced plasma flow control methods will be used to increase the glide ratio and flight time. Wing mounted flexible solar cells based on optical rectenna technology can provide additional 50 kW or at least 25 kW using state-of-the-art solar cells with 30% efficiency. Possible near infrared, terahertz or microwave power transmissions to flexible underwing rectannas are additional onboard lightweight power tools [1].

Electrofluidsystems announced the first breakthrough for future air-breathing magneto-plasma propulsion systems with the release of a new Star Wars movie in December 2015 and presented a first prototype at the ILA Berlin Air Show in June 2016. The first scientific paper was published in April 2017 discussing the working principle of the new pulsed plasma engine based on Lorentz forcing through a set of arc discharges with self-induced magnetic fields,

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Fig. 3-4 [5] The new paper will also discuss first high-speed camera recordings with a Photon FastCam SA-Z, Fig. 5-6.

Supplementary data with figures available at http://www.electrofluidsystems.com/Goeksel-HTPP15-Abstract1.pdf

Morris Jr., C. E. K., "Microwave-Powered, Unmanned, High-Altitude Airplanes," *AIAA Journal of Aircraftl*, Vol. 21, No. 12, 1984, pp. 966-970.

Kohout, L. L., and Schmitz, P. C., "An Analysis of Fuel Cell Options for an All-Electric Unmanned Aerial Vehicle," NASA TM-2007-214699, 2007.

Petermaier, K., "Electric Propulsion Components with High Power Densities for Aviation," Presentation at the Transformative Vertical Flight Workshop, 2015.

Anton, F., "Elektrische Antriebssysteme für Luftfahrzeuge," English presentation at the Bayerischer Fliegertag, 2017. URL:

Goeksel, B., Mashek, I. "First Breakthrough for Future Air-Breathing Magneto-Plasma Propulsion Systems." Journal of Physics: Conference Series, Vol. 825, 2017, 012005.