

PROJECTWORK OF MODEL PUD-BJ »FROM IDEA TO PRODUCT« SOLAR AIRPLANE DRON II

PROJEKTNO DELO PO MODELIH PUD-BJ »FROM IDEA TO PRODUCT« - SOLAR AIRPLANE DRONE II

Luka Artelj, Edvard Trdan, Jožica Bezjak

Abstract

Unmanned Solar-Powered Aircraft (USPA) is an experimental prototype powered by solar energy. It has two control surfaces for altitude and heading, it also has an electrical motor with a foldable propeller, and a system for ensuring electrical energy for the whole plane. Such construction enables beneficial gliding characteristics, when the motor does not spin the propeller is folded. The main problem of every unmanned aircraft is the limited flight time, so our goal is to maximize the flight time. For USPA we decided because of the problems of our previous aircraft that had limited flight time. This was the main obstacle, so this time we decided to develop an aircraft that would have enough energy for the whole-day flight. The most suitable approach was an aircraft with gliding characteristics and big surface area of the wings. Solar cells area mounted through the whole surface of the wing to provide as much energy as possible to charge the batteries. The goal of the project is a whole day flight up to 16 hours only by the use of solar energy and batteries.

Our first USPA prototype (with registration S5-GJL) was smaller solar plane, with a wingspan of 1600 mm and was able to fly up to 3 hours. Tests have confirmed that this USPA – 1 had too small wings and photovoltaic cells mounted on it did not produce enough energy for a full day flight. Based on the experience with the first prototype, we have built the second, bigger USPA – 2 with registration S5-GAL, which is able to fly for the whole day, until the sun is shining, up to 16 hours in summer months because it has bigger wings and more solar cells. Therefore, we are presenting S5-GAL USPA – 2 in this project. The project was very difficult because USPA is a thing of the future, and up to now and there are available only limited sources of the literature. The specifications of USPA are as follows: wingspan 2650 mm, aircraft length 1430 mm, wing surface area of 50 dm² with 34 photovoltaic cells with a total power of 50 W. These cells produce electricity to charge the batteries through a special charger, which allows simultaneously charging and discharging of the batteries and supply power to electrical motor. Using the batteries USPA is also able to fly at night, of course the batteries are not charging at that time. Weight of fully assembled aircraft is about 1200 g, the maximum take-off weight is 2000 g. It has a two bladed propeller of 305 mm in diameter, rotating at 7125 rpm, powered by electric motor with a power of 108 W, connected to two li-ion battery (cell code 18650) with a 33 Wh capacity and mass of 200 g. In order to reduce the weight and to obtain the crucial stiffness we constructed the wing design whit wood ribs. The take-off speed is 25 km/h and the cruise speed is 35 km/h. The best flight altitude is about 200 meters, the maximum altitude is approximately 500 meters, with flying time up to 16 hours. USPA has also an integrated autopilot, which controls the whole aircraft. We control USPA by radio transmitter or by a computer. Beside this, we have also install the camera and video transmitter that transmit live image to the operator. USPA is an important factor in longer flight time off different unmanned aircraft that can be used in school project, for firefighters, in military purpose, for geodesy, for search and rescue, for surveying, etc. The flight time is still a problem, but we solved this problem and achieve the impossible. We improved flight time significantly, so we are highly satisfied with the results. Although, results of the current USPA are inspiring, even better results are expected in the summer time, when days will be longer and stronger sun exposure will enable even longer flight time.

Keywords: *unmanned solar-power aircraft (USPA), solar cell, battery, electric motor, autopilot, video transition*

Abstrakt

Solarni brezpilotni aeroplan je eksperimentalno brezpilotno letalo, ki ga poganja sončna energija. Ime dve krmilni površini za višino in smer, pogonski motor z zložljivim propelerjem in sistem za sprotno zagotavljanje električne energije. To mu omogoča jadralne karakteristike, jadranje, ko se motor ne vrti in je propeler pospravljen. Problem vsakega električnega letala je omejen čas letenja, zato je glavni cilj projekta, da se čas letenja podaljša.

Za projekt »Solarni brezpilotni aeroplan« sem se odločil zaradi težav z letali izdelanimi v mojih prejšnjih projektih, ki so vsi imeli omejen čas letenja. To je bila največja ovira, zato sem se tokrat lotil razvoja letala, ki bi imelo dovolj energije za celodnevni let. Najprimernejši pristop je letalo z jadralnimi karakteristikami in veliko površino kril, na katerih so po vsej površini nameščene sončne (fotovoltaične) celice, ki polnijo akumulator. Cilj projekta je letalo za celodnevni let, do 16 urni neprekinjen let z uporabo sončne energije, ki napaja akumulatorja.

Moje prvo solarno letalo z registrsko oznako S5-GJL je bilo manjše (premer čez krila 1600 mm) in je lahko letelo do 3 ure. To letalo je imelo premajhno površino kril, da bi sončne celice proizvajale zadosti energije za celodnevni let. Z izkušnjami prvega prototipa sem zgradil naslednje, lažje in večje letalo (S5-GAL), ki lahko leteli cel dan, dokler je sonce (v poletnih mesecih do 16 ur) in ga predstavljam v tem projektu. Projekt je bil zahteven, saj je solarno letalo stvar prihodnosti in do sedaj skoraj ne obstaja nobenega vira literature s katerim bi si lahko pomagal. Karakteristike novega solarnega brezpilotnega aeroplana so: Razpon kril je 2650 mm in dolžina letala 1430 mm. Površina kril je 50 dm², na njih je 34 sončnih celic s skupno močjo 50 W. Te celice proizvajajo električno energijo za pogon motorjev in polnjenje akumulatorjev preko posebnega polnilnika, ki dopušča istočasno polnjenje in praznjenje akumulatorjev. S pomočjo akumulatorjev lahko leti tudi ponoči, a se takrat akumulatorja ne polnita. Naložena teža letala je 1500 g, maksimalna vzletna teža pa je 2000 g. Poganja ga elektromotor z močjo 108 W. Motor poganja dvokraki propeler premera 305 mm in 7125 obrati na minuto. Letalo ima dva pogonska akumulatorja, vsak ima 33 Wh, 3 li-ion celice z oznako 18650 in maso 200 g. Krilo je zgrajeno iz lesenih reber s čimer dosežemo majhno težo. Vzletna hitrost je 25 km/h, potovalna hitrost je 35 km/h. Običajna višina leta je 200 m, največja pa 500 m. Avtonomija letenja je 16 ur. Letalo ima vgrajen tudi avtopilot, ki ga upravlja med letom in se brezžično vodi z računalnikom v krmilni napravi. Letalo ima tudi kamero in video prenos, ki prenaša sliko od letala do operaterja v realnem času. Solarni brezpilotni aeroplan je pomemben prispevek k podaljševanju časa letenja (avtonomije), ki je še vedno največji problem. Ta čas mi je uspelo krepko podaljšati, zato sem z rezultati zelo zadovoljen. Testiranja so še v teku, še boljše rezultate pričakujem poleti, v daljših in sončnih dneh.

Ključová slova: brezpilotni aeroplan, sončna celica, akumulator, elektromotor, avtopilot, video prenos

Contact

Luka Artelj, Edvard Trdan, B.Sc., Secondary School for Technical Professions Šiška, Ljubljana,
Ass.Prof.Ph.D.Ph.D. Jožica Bezjak, University of Primorska, Faculty of Education Koper, Slovenia