IAF SPACE POWER SYMPOSIUM (C3)
Advanced Space Power Technologies (3)

Author: Dr. Antonio Pedivellano
DcubeD (Deployables Cubed GmbH), Germany, antonio.pedivellano@dcubed-space.com

Dr. Thomas Sinn
DcubeD (Deployables Cubed GmbH), Germany, thomas.sinn@dcubed-space.com
Mrs. Ambre Raharijaona
DcubeD (Deployables Cubed GmbH), Germany, ambre.raharijaona@dcubed-space.com
Mr. Michael Kringer
Munich University of Applied Sciences, Germany, michael.kringer@dcubed-space.com
Mr. Joram Gruber
DcubeD (Deployables Cubed GmbH), Germany, joram.gruber@dcubed-space.com
Mr. Thomas Lund
DcubeD (Deployables Cubed GmbH), Germany, thomas.lund@dcubed-space.com
Mr. Alexander Titz
DcubeD (Deployables Cubed GmbH), Germany, alexander.titz@dcubed-space.com
Mr. Joachim Schmidt
DcubeD (Deployables Cubed GmbH), Germany, joachim.schmidt@dcubed-space.com
Ms. Nisanur Eker
DcubeD (Deployables Cubed GmbH), Germany, nisanur.eker@dcubed-space.com
Mr. Stefan Titze
Germany, stefan.titze@th-deg.de
Prof. Mathias Harthmann
Germany, mathias.hartmann@th-deg.de
Mr. Diego Garcia
German Orbital Systems GmbH, Germany, diego.garcia@orbitalsystems.de
Ms. Daria Stepanova
German Orbital Systems GmbH, Germany, daria.stepanova@orbitalsystems.de
Mr. Tim Kubera
Germany, tim.kubera@azurspace.com
Dr. Pauline Faure
California Polytechnic State University, United States, pfaure@calpoly.edu
Ms. Bailey Garrett
California Polytechnic State University, United States, bgarre01@calpoly.edu
Mr. Callan Whitney
California Polytechnic State University, United States, crwhitne@calpoly.edu

MORE POWER FOR SMALL SATELLITES: AN OVERVIEW OF A ONE-SQUARE-METER 100W DEPLOYABLE SOLAR ARRAY STORABLE IN A 1U FORM FACTOR

Abstract

The advent of NewSpace has tremendously accelerated the trend towards the miniaturization of satellites and established nanosatellites as the go-to platform for future scientific and commercial space applications, from Earth orbit to deep-space. From on-board data processing and artificial intelligence to electric propulsion and laser communications, many advanced capabilities are associated with significant power consumptions, beyond what state-of-the-art SmallSat solar arrays can offer.

PowerCube addresses this challenge by proposing a next-generation solar array that achieves unprecedented power levels for the class of Nano- and SmallSats. This 1-square-meter, 100-W solar array fits in a 1U volume and is passively deployed by releasing the elastic energy stored during packaging. To generate such high power levels, PowerCube relies on a high-packaging efficiency deployable structure, to maximize the deployed area per stowed volume, and on high-efficiency solar cells, to maximize the absorbed power per unit area.

This paper will offer an overview of the ESA-funded PowerCube project, carried out by Deployables Cubed GmbH in partnership with German Orbital Systems GmbH, AzurSpace GmbH, and Deggendorf Institute of Technology. The key technologies enabling this innovative system will be described, including its origami-inspired architecture, the dual-matrix composite substrate, high-efficiency GaAs solar cells, an extraction mechanism to initiate the deployment, and a maximum power point tracking circuit to match the power requirements from the EPS.

An application case of the PowerCube solar array to space solar power will be presented in the context of PowerSat, a 3U CubeSat developed by the California Polytechnic State University (CalPoly) and selected for launch on a NASA ElaNa mission in 2023. This in-orbit demonstration mission has the objective to demonstrate the feasibility of space-based solar power from CubeSats by combining the 100W solar array with a LED-based optical beacon, visible from Earth.