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Author: Dr. Omid Shekoofa
Satellite Research Institute, Iranian Space Research Center, Iran

Mr. Sajjad Ghazanfarinia
Iran
Ms. Maryam Baghban Kondori
Satellite Research Institute, Iranian Space Research Center, Iran

USING SPACE ELEVATOR TO BRING SPACE-BASED POWER PLANTS' ENERGY DOWN TO EARTH

Abstract

The concept of space-based power plants (SBPP), or space solar power system (SSPS), has been regarded as a potential solution for powering the future world, since the 1970s. Among the different proposed concepts for transmitting the energy from SBPP to the earth so far, perhaps the idea of wireless power transmission has been remained unchanged. The realization of SBPP has been delayed for more than a half-century because of several major challenges such as big required budget, low TRLs, and safety issues. The safety concerns, are probably the most complicated challenges that should be faced. Besides, the wireless transmission of high power is very difficult and still not efficient enough.

Another breakthrough idea is "Space Elevator" which was firstly proposed by Konstantin Tsiolkovsky in 1895, and later on, was discussed more scientifically by Yuri N. Artsutanov on 1960. Since then, many studies have been conducted to develop a feasible concept of it. Some of the main existing challenges in development of space elevator are the cable material, beam-powering the elevator, and need for a counterweight in high earth orbit and at the apex anchors (in the space docks).

The introduced idea in this paper came out from the combination of the two above mentioned concepts. In fact, the main part of this idea is to use the space elevator cable as the SBPP power transmission line. Defining such function for the elevator tether, the majority of technical and safety challenges related to wireless power transmission will be essentially eliminated. In addition, if the cable can be fabricated from the highly electrically conductive nanomaterials such as graphene, the power transmission will be more efficient than of the wireless case. On the other hand, the whole elevator system can be powered directly and there is no need for beam powering of the climber segment.

In a fully deployed "SBPP plus space elevator" system, the main structure of the SBPP can not only act as the space port of the elevator, but also as the counterweight for balancing the elevator, and no additional space dock is required. Furthermore, if a space elevator is available, the development and expansion of SBPP systems will be much cheaper and faster because the expensive and risky launchers will be no longer necessary. Therefore, in case of happening, this breath-taking system may be the best economic justification for both space elevator and SBPP.