

03/2201 Laser power beaming feasibility: non-mechanical beam steering options, laser phase-locking and control

Type of activity: Fast Study (2 months, 15 KEUR)

In the frame of solar power from space concepts (Solar Power Satellites, Space Solar Power Stations, Solar Power Platforms, etc), most of the concepts use microwave frequencies for wireless power transmission from Space to Earth. Wireless power transmission via lasers are often regarded as too advanced for larger studies, since laser generation efficiencies are still considered too low.

For space-to-space laser power transmission applications, ranging from powering a free flying high quality microgravity spacecraft at vicinity of the ISS for example, to enhancing the power available to GEO satellites, powering LEO satellites during eclipse periods as well as powering lunar and Martian surface outpost (manned or unmanned) from orbiting power stations, the laser option would offer many advantages, especially small receiver antennas. Currently studies to power a lunar polar rover via laser power transmission receive considerable attention in the US (Boeing) and Japan. EADS ST (Europe) has recently developed a small demonstration rover entirely powered by a remote laser beam.

One of the unsolved problems for larger space applications would be the lack of lightweight and fast beam steering technologies for a laser beam generated by a multitude of laser cavities. Diode laser arrays with relatively high efficiencies are currently considered the most promising option. Mechanical optical steering devices are most probably massive and the requirement of moving parts in space is prohibitive. Electronic phase control already offers fast and efficient beam steering in the microwave wavelength.

This study shall investigate the principal feasibility of laser beam steering by phase locking and phase control of an array of multiple lasers (e.g. laser diodes). The study shall determine potential principal showstoppers, identify theoretical solutions and eventually compare different technical approaches to the problem.

References:

[1] Henley M., *Space Solar Power Development at Boeing*, presentation at SCTM NASA Technical Interchange Meeting, Cleveland Ohio, Sept. 2002

[2] Luce R., Michael S., *Laser Beaming Experiment*, presentation at SCTM NASA Technical Interchange Meeting, Cleveland Ohio, Sept. 2002

[3] Botez D., Mawst L., Phase-locked Laser Arrays Revisited, *IEEE Circuits & Devices*, pp. 25ff, 1996