NASA SBIR/STTR Technologies

Advanced High Efficiency Lighting System with Intelligent Control

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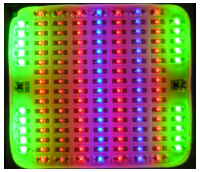
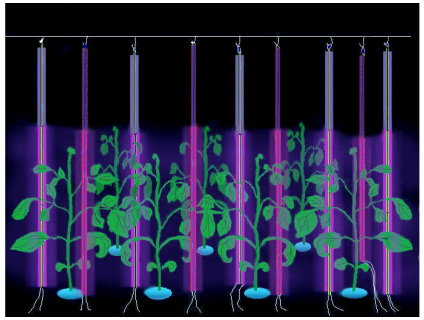
Identification and Significance of Innovation

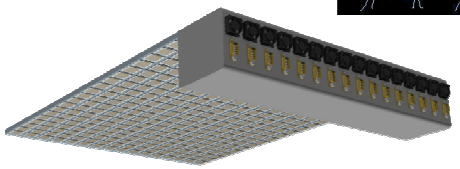
Lighting is the most critical subsystem in the biomass production component of an advanced life support system. It is certainly one of the primary power draws on these systems. Solid state lighting offers significant advantages over existing lamp types. By utilizing innovative control strategies and circuit design, the efficiency of LED systems can be enhanced by matching wavelengths to plant photoreceptors, using plant location sensing to ensure that only those light engines adjacent to photosynthetic surfaces are powered, and by automatic optimization of lighting based on feedback from the biological system (e.g. matching spectral output to plant development stage). The use of solid state lighting eliminates problems associated with traditional lighting in closed systems such as short operational life (requiring resupply), high mass and volume, limited control options, and safety concerns including high temperatures, glass envelopes, and toxic materials.



Multispectral LED light "engine" (1 in^2)



Intracanopy lighting configuration



Planar lighting configuration

Technical Objectives

The Technical Objectives of this project are to develop a high efficiency lighting system using advanced control systems to dynamically optimize the system for a given situation. The outputs of this projects will include the design and prototype of integrated plant position sensing mechanisms, and a conceptual design of an intelligent lighting control system scalable to accommodate a 6 person bioregenerative life support system.

Work Plan

- Task 1 Develop spectrum specific feedback mechanism
- Task 2 Develop plant position sensing capability
- Task 3 Develop circuitry for high resolution, 2-D selective lighting control
- Task 4 Develop advanced lighting control prototype
- Task 5 Conduct testing of advanced control prototype
- Task 6 Develop concept for large scale, integrated "biofeedback" system
- Task 7 Management and Reporting

NASA Applications

The advanced lighting system can support the production of biomass in closed environments to support long-term planetary exploration and human settlement. It would also support near-term bioregenerative systems providing partial water and air reclamation for transit missions or early planetary missions.

Non-NASA Applications

Advanced LED systems can help make intensive agriculture systems feasible and can replace existing light systems used for plant growth in research, education and recreational settings, and in advanced specialty growth systems.

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