

Space Farming and Food Printing: Integrating CEA Hydroponics, ISRU, and 3D Food Printing for Sustained Human Presence in Space

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Abstract

Ensuring sustainable food production is a critical challenge for long-duration space missions and future planetary habitats. This presentation explores the integration of Controlled Environment Agriculture (CEA) with hydroponic systems, In-Situ Resource Utilization (ISRU), and 3D food printing technologies to enable efficient, resilient space farming and food preparation.

By leveraging hydroponic CEA systems, optimized for closed-loop environments and minimal resource consumption, we can grow fresh crops in space with precise control over nutrients, water, and lighting. ISRU strategies are examined to reduce reliance on Earth-based supply chains, including the recycling of water and nutrients, use of regolith-derived substrates, and atmospheric processing.

Furthermore, 3D food printing offers a promising solution for transforming raw plant biomass and shelf-stable ingredients into nutritious, palatable, and customizable meals, potentially enhancing crew morale and dietary variety.

The talk will highlight experimental setups, system integration challenges, and future pathways for deploying these technologies in orbital and planetary missions, with the ultimate goal of supporting human life beyond Earth.

Giorgia Pontetti - un bio essenziale

Giorgia Pontetti is an electronic and astronautical engineer with a deep-rooted passion for both cutting-edge technology and the natural world. Despite pursuing rigorous technical studies in the 1990s, her connection to agriculture—passed down through generations of her humble, farming family—has remained a constant and vital part of her life. For Giorgia, nature is more than a background; it is a source of vitality and inspiration.

She is the CEO of **G&A Engineering**, a research center specializing in microelectronics for space applications and the design and production of special equipment for the aerospace, defense, automotive, and hydroponic sectors. In addition, she is the founder and CEO of **Ferrari Farm**, a next-generation agricultural enterprise focused on hydroponic cultivation within sterile, hermetically sealed, and fully computerized greenhouses.

A dynamic advocate for innovation, Giorgia serves as Vice President and Secretary of the **Space Exploration Commission** at the Order of Engineers of the Province of Rome. She is also a board member of **Women4Cyber Italia** and an active journalist, contributing her expertise and vision at the intersection of technology, sustainability, and space exploration.