



Symposium 2 : *Human interaction with ecosystems*

*Design innovant de systèmes de supports de vie pour
l'exploration spatiale habitée*
***Innovative design of advanced life support technologies for
human space exploration missions***

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Abstract — One of the main objectives for long duration space flight is to design advanced Life Support Systems (L.S.S) which are autonomous, reliable and safe. The next generation of such L.S.S. will be conceived on the basis of living systems (algae, bacteria, higher plants, ...) which is an integrative and interdisciplinary challenge with a large range of possible technologies.

The purpose is to find ways to reconstitute the near earth environment for future human exploration missions which is a critical stake for long term stays in microgravity on Moon, Mars or other extraterrestrial bodies. In other words, biogenerative life support systems have to take over the functions of plant and soil in earthly nature, which are oxygen (O₂) regeneration, carbon dioxide (CO₂) incorporation and reuse of organic wastes as well as water supply.

In this communication, we will propose a systemic inter-species approach with a wide innovative modelling loop, because we think that the classical modelling approach can not allow to address the complexity of such hybrid living systems technologies which are often multi-scale, multidimensional, non linear, non monotonic and strongly entangled temporarily.

Our innovative approach for the design of advanced L.S.S. will be sustain by the use of system dynamics modelling and fuzzy logic technology. This approach partially tested in other contexts should allow to overpass some difficulties met in previous projects in this field of research.

Keywords: *Life support technologies, human space exploration missions, complex modelling*