

## ***06/6301 Bio-inspiration from Plants' Roots***

Type of activity: Medium Study (4 months, 25 KEUR)

### **Background and Motivation**

#### **Bio-inspiration**

Plants show good capabilities of looking for nutrients without the need of a complicated locomotion system. They can survive in very harsh environments and are also able to successfully replicate themselves. Roots do not only strongly anchor the plants into the soil but are also capable to gather signals by their embedded sensors. These signals are then transduced, processed and used for plan strategy control in order to find the optimal path for roots' growth. Autonomous systems having adaptable, path-finding and intelligent roots equipped with actuators and integrated sensors are appealing for future research and study. There are several engineering areas that could be bio-inspired by plants' roots, e.g. material science, measurement and sensing, mechatronic design, control strategies, signal processing, adaptive behaviour, etc.

#### **Applications**

Simple, lightweight and compact payloads capable to dig into the soil searching for past and present signs of life have potential applications in space. Bio-mimicking the holistic design of plants' roots could lead to the design of self-optimising high-performance engineering systems suitable for space exploration. The technology readiness seems now to allow preliminary engineering studies and research in this topic.

#### **Research and Study Objectives**

This study should cover:

- review of natural plant root sensors, actuators, intelligence, control and behaviour
- assessment of engineering potential in terms of feasible mechanisms and suitable materials
- identification of possible space scenarios for a payload inspired by plants' roots
- identification of current technological show stoppers
- proposal of a novel bio-inspired mechatronic system design for future space applications

#### **References**

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- [4] Baluška F., Mancuso S., Volkmann D. and Barlow P., “Root apices as plant command centres: the unique ‘brain-like’ status of the root apex transition zone”, *Biologia*, Bratislava, 59/Suppl. 13: 7-19, 2004.
- [5] Baluška F., Volkmann D., Hlavacka A., Mancuso S., Barlow P. W., “Neurobiological View of Plants and Their Body Plan Communication in Plants”, Baluška F., Mancuso S., Volkmann D. (Eds.), Springer-Verlag Berlin Heidelberg 2005.

