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Author: Mr. Thomas Maier
Deutsche Gesellschaft für Luft-und Raumfahrt, Lilienthal-Oberth e.V. (DGLR), Germany

Mr. Lukas Kamm
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

MOISTURE SENSOR FOR GRAVITATION DEPENDENT PLANT WATERING

Abstract

A recent project of the German Aerospace Center (DLR) is the so called Eu:CROPIS project. Its main purpose is to study the influence of different gravitational forces on the growth of plants and vegetables. The setup consists of a satellite in orbit around Earth which is rotating around its own axis in order to imitate the gravitational pull of Mars and the Moon. Inside, two small greenhouses are located with tomato seeds growing on top of 1 cm of a lightweight, sponge-like material. The sponge is soaked with water from below and the water spreads upwards because of the capillary forces in the sponge. The problem now is that the water moving upwards will only reach a certain height until the capillary force is equal to the gravitational pull simulated by rotating the satellite. As a consequence, the seed on top of the sponge is not soaked and will not germinate. On the contrary a too wet sponge is likely to get moldy. The purpose of this work was to build a sensor which can measure the moisture of this sponge only on its surface in a depth of about 1 mm. The moisture further inside the sponge should not be measured since it is not relevant for germinating the seeds. Furthermore, the sensor must not influence the satellites ecosystem in any way. In this paper different sensor types and measuring principles are discussed at first. As a result, a capacitive measuring method is chosen as most adequate. The sensors dimensions are then being adapted in order to limit the penetration depth of the electric field. This enables a very thin measurement layer on top of the sponge. Different insulation methods, their influences on the ecosystem and the measured capacity are regarded by proposing a suitable equivalent circuit diagram. The sensor is now finished and is currently being integrated in the satellite. The launch is scheduled for the first to second quarter of the year 2018 and will be performed by SpaceX with a Falcon 9 rocket.