TOWARDS AN ASTROBIOLOGICAL VISION FOR THE OUTER SOLAR SYSTEM: THE EUROPA AND ENCELADUS EXPLORER MISSION DESIGNS. K. Konstantinidis[1], C. L. Flores Martinez[2], M. Hildebrandt[3], and R. Förstner[1], [1]Bundeswehr University Munich, Institute for Space Technology and Space Applications, Werner-Heisenberg-Weg 39, 85579 Neubiberg, Bavaria, Germany, e-mail:k.konstantinidis@unibw.de [2]University of Heidelberg, Centre for Organismal Studies, Im Neuenheimer Feld 234, 69120 Heidelberg, Baden-Wurttemberg, Germany, e-mail: c.flores@stud.uni-heidelberg.de, [3]German Research Institute for Artificial Intelligence (DFKI), Robert-Hooke-Straße 5, 28359, Bremen, Germany, e-mail: marc.hildebrandt@dfki.de

Introduction: The firmly astrobiologically oriented exploration of the Solar System promises to revolutionize our understanding of how and where life in the Universe can originate, evolve and develop. In case organisms, which arose independently from terrestrial life, can be discovered beyond Earth, general notions of evolutionary biology, planetary science and even cosmology will undergo revision in light of more widespread biological activity throughout the Cosmos. In more practical terms the great hypothesis of a living Universe can only be verified, or falsified, via advanced robotic exploration and *in situ* sampling of putative alien biospheres. Since the highly successful Galileo and Cassini missions revolutionized our understanding of the outer Solar System, we can now be almost certain that more habitable regimes, than for example on Mars, have been identified within the subsurface environments of Jupiter's moon Europa and Saturn's Enceladus. Here, the process of emerging and evolving biological complexity is assumed to operate analogously among different putative planetary biospheres. This can be a helpful first assumption in guiding the design and construction of advanced robotic missions and adequate instrumentation that will aid in the eventual detection and characterization of biological activity on Europa and Enceladus.

The Potential for Life on the Icy Moons of Jupiter and Saturn: A comparative discussion of the astrobiological potential of the icy moons Europa and Enceladus, arguably the two prime targets across the outer Solar System, is given – in respect to the triad of parameters relevant to the concept of "life as we know it" (liquid water, biogenic elements and energy sources). Further, it is also considered how life could emerge within the subsurface environments of both moons from hydrogeological serpentinizing systems, subsequently evolve, and how differing degrees of biological complexity can be expected among the two kindred but far from identical planetary habitats.

Europa and Enceladus Explorer Mission Designs: Two DLR funded (National Aeronautics and Space Research Centre of the Federal Republic of Germany) mission concepts are presented:

Enceladus Explorer (EnEx) aims to design a mission to Enceladus, as well as to develop an operable drilling technique to penetrate the icy surface of the moon using the IceMole, a novel maneuverable subsurface ice melting probe for clean sampling and in-situ analysis of ice and subglacial liquids. The EnEx mission concept under development at the Institute for Space Technology and Space Applications (ISTA) of the Bundeswehr University Munich is comprised of a Lander carrying a nuclear reactor providing 5 kW of electrical power, and the IceMole, and an Orbiter with the main function to act as a communications relay between the Lander and Earth. After launch, the combined spacecraft uses the on-board nuclear reactor to power electric thrusters and eventually capture around Enceladus. The Orbiter then performs a detailed reconnaissance of the south polar terrain at Enceladus. At the end of the reconnaissance phase, the Lander separates from the Orbiter and autonomously lands near one of the active vapor plumes, where the IceMole is deployed and starts melting through the ice towards the target subglacial water bearing crevasse, adjacent to an active plume.

Europa Explorer's (EurEx) scope is the design of a fully integrated autonomous under-ice exploration system, which will be prototypically built by the DFKI (German Research Institute for Artificial Intelligence) and tested in arctic environments on earth in the course of 2013-2015. The focus in this project is the complete terrestrial demonstration of the feasibility of such an approach, especially the demands for navigation under the ice. The navigation system's role is critical for the mission: if the under-ice vehicle cannot return to its starting location (penetration point), no data can be transmitted back to earth, failing the complete mission. As a result the navigation system uses a combination of acoustic, optical and inertial localization techniques to ensure high-quality low-drop-out results.

Fusing Icy Moon Research Paths: Coupled with field work at terrestrial analogues of the icy moons (which is already taking place in the context of both projects with future expeditions already planned), such as, for instance, the (deep) sea below the Arctic and Antarctica, subglacial lakes and other ice-dominated environments, the cross-pollination between Europa and Enceladus mission requirements, designs, and usable prototype instrumentation could help in forging an interdisciplinary research program aimed at realizing the astrobiological vision for the outer Solar System.