

Session IV

20 Years From Now

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NextFish

Introduction

The object of this session was to conclude the first three technology sessions by looking into the future 20 years ahead. Each author was requested to think outside-the-box and attempt a vision of what might be available in the year 2022. Some authors were visionaries, other accepted a very low percentage gain in their technology area. Some authors presented material, others talked about it. The presentation material was in vu-graph format.

Batteries

Quantum technology jumps in battery technology can only be obtained with new chemistry. Respectable increases are achievable by optimizing the engineering problems. Edgar An of Florida Atlantic University envisions the use of lithium polymer batteries for small AUVs and fuel cells for the larger AUVs. The lead-acid batteries presently in use in the larger submarines will continue to improve using VRLA: Valve Regulated Lead Acid technology. Pat Imhof of BST sees 2x increases in capacity retention, cycle life, and wet life of Ag/Zn batteries. Lithium Ion technology will certainly be a key player in the small AUVs, according to N. Raman of Saft.

Fuel Cell

The military sector envisions continued improvement in fuel cell technology in system design, efficiencies, and reliability. Frano Barbir of Proton Energy Systems sees hydrogen based modern civilization. He presents some interesting graphics, and ends his presentation with a quote from Jules Verne Mysterious Island, 1874, "Water will be the coal of the future." George Hagerman envisions the "Magellan Under the Sea" expedition of 2022: robot subs powered by a series of wave-powered filling stations. Michael Adams of Fuel Cell Technologies expects a continual increase in neutrally buoyant energy densities, up to 350 Wh/Kg for solids managed systems. Oisten Hasvold of the Norwegian Defence Research Establishment is more conservative. Present alkaline Al/hydrogen peroxide semi-cells could improve from 100 Wh/Kg to 130 Wh/Kg and variants could go as high as 200 Wk/Kg.

Other Energy Systems

Flywheels may not sound exciting, but they may have a place in AUVs depending on the mission. Technology will be able to increase system level energy stored per unit weight and volume by a factor of 5 to 10. Cryogenics will promote fuel cell

technology along with superconductivity applications. Hydrocarbon fueled systems could increase energy density to 500+ Wh/Kg for turbine based systems and to 750 Wh/Kg for Sterling engine systems. The issue here is system endurance. On a total system basis, technology will increase system efficiency by 50%, but at the cost of increased system complexity. Lastly, solar powered AUVs: system efficiency should increase 5 fold, from 3% to 15%.

Summary

Many different energy sources and systems have been discussed. System efficiency will improve in time. The energy issue will be to tailor the energy source with the mission requirements.