# Introduction to the Special Section on the Electromagnetic Properties of Sea Ice

APPROXIMATELY 13% of the world's oceans is covered by sea ice during some portion of the year. This volume of ice has significant effects on the world's climate, ocean currents, and biological ecosystems. Furthermore, the extent of sea ice cover is used as an input parameter in many meteorological forecasting models. It is difficult to obtain ground-based measurements over large regions of the Arctic, where the distances are vast, the climate is hostile, and the operations are expensive. The material composition of sea ice varies with temperature and winds. Thus, remote sensing of sea ice may be the preferred method to obtain quantitative information about sea ice.

This Special Section of the IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING presents results obtained by the Accelerated Research Initiative (ARI) on the Electromagnetic Properties of Sea Ice (EMPOSI) that was sponsored by the Office of Naval Research (ONR), Washington, DC. Briefly stated, the ARI had three broad objectives, as follows.

To better understand the mechanisms and processes that link the morphological characteristics with its electromagnetic properties.

To further develop and verify predictive models for the interactions of visible and microwave radiation with sea ice.

To develop and verify the techniques in the mathematical theory of inverse scattering theory that are applicable to problems arising from interactions of electromagnetic waves with sea ice.

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Remote sensing is an application of electromagnetic inverse scattering theory—so called because it inverts the traditional direct (or forward) concept of physical phenomena: the cause determines its effects. Inverse theories seek to determine the cause from its effects; in general, they are mathematically oriented and computer intensive. The EMPOSI ARI provided a unique opportunity to design sea-ice remote-sensing experiments and coordinate them with the sea ice physics and the corresponding mathematical inverse scattering models of the electromagnetic interactions of sea ice. This was a combined effort of several *ad hoc* groups of theoreticians and experimentalists working together on various aspects of the ARI. The cooperation of the groups and individuals is evident from the contents of this Special Section. The majority of the ARI laboratory experiments were conducted on the indoor and outdoor ice ponds at the United States Army Cold Regions Research and Engineering Laboratory (CRREL), Hanover, NH; the ARI field experiments were conducted at Point Barrow, AK.

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**Arthur K. Jordan** (M'59–SM'74–F'91–LF'96) received the B.Sc. degree in physics from the Pennsylvania State University, University Park, in 1957, and the M.Sc. degree in 1971 and the Ph.D. degree in 1972, both from the Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, in electronics engineering.

In 1973, he joined the Naval Research Laboratory, Washington, DC, conducting research in electromagnetic inverse scattering theory with applications to remote sensing and optical waveguides and devices; he is now a member of the Remote Sensing Physics branch in the Remote Sensing Division. From 1987 to 1996, he also had a part-time (one day/week) appointment with the Electronics Division of the Office of Naval Research, managing the electromagnetics research program. During the academic year 1989–1990, he spent a sabbatical at the Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, and now has an appointment there as a Visiting Scientist.

Dr. Jordan received the IEEE Fellow award in 1991 and the Optical Society of America Fellow award in 1993, both for electromagnetic inverse scattering theory and its applications.