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Discussion III—Summary*

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The range of geotechnical interests covered by the papers presented in this symposium is impressive: surface and subsurface water, soil moisture, vegetation, snow, shorelines, lineaments, mining, and subsidence. The spectral range covered extends from the visible through the infrared to radar. The techniques of data processing include density slicing, band ratio analysis, spatial filtering, inverse filtering, image subtraction, optical correlation, and analysis of multiple data sets. In addition, papers are included on remote data telemetry, as applied to geotechnics.

It is clear that geotechnical needs for remote sensing are real and that remote sensing capabilities for meeting many of these needs are already available. In fact, there are abundant sources of remote sensing data on hand which can be used in present and future geotechnical studies.

With the dramatic growth in recent years of environmental concerns and of resources for addressing those concerns, the increasing application of remote sensing and remote data telemetry to the geotechnical components of environmental investigations is inevitable.

In introducing any body of sophisticated techniques to a complex problem area, there is always the hazard that the mixing of scientific activities based on disparate competencies—in this case, data from the remote sensing/data telemetry area, on the one hand, and from the geotechnical on the other—will lead to amateurish results, or worse. In the case before us, however, this interchange has been going on for some years and cross-discipline competencies have been developing, as is evidenced by the content of the papers in this volume. No sermon is needed here on the significance of ground truth, or on the need for the design by competent specialists of remote sensing surveys or the interpretations of remote sensing results.

All communication gaps have not been closed, however. Some type of forum is needed to facilitate effective technical communication not only between the remote sensing/telemetry specialists and the geotechnical specialists, but also across the industry, government, and academic lines transecting these groups. For example, the wealth of available, stored remote-sensing data applicable to geotechnical work has been tapped only slightly. There could be much greater discourse on the applicability of proved remote sensing/data telemetry methods to geotechnical investigations and on needs in geotechnics for new developments in remote sensing and data telemetry.

One way to facilitate communication and cross-discipline competencies is to provide adequate, appropriate instrumentation for both teaching and research in the universities. The funding of such a development cannot be expected to come from existing university resources; in the United States, government, quasi-government, or industry funding sources will have to be found.

In developing remote sensing and data telemetry techniques in the future, it is important to keep in mind the range of technical, managerial, and financial capabilities of prospective users. A technique suitable for a national geological survey or a multinational geotechnical consortium

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might be completely out of the reach of the geotechnical firm consisting, say, of one professional, one technician, and a part-time typist. A small firm might be able to purchase the needed service from a larger organization, but this might not be feasible for a particular site or particular type of study needed. Some attention does need to be given to the technical requirements of the small firm.

Which of the applications covered in this volume's papers are susceptible of being transformed into ASTM standards—such as practices or guides; which areas of geotechnical practice need ASTM guidelines for remote sensing or data telemetry? One of the purposes of the symposium on which this volume is based was "to evaluate the possibility that the science is sufficiently developed so that some standards, possibly of the recommended practice type, at least, could be developed to assist the geotechnical specialist in selecting and using these techniques in the most useful and efficient manner." Straightforward answers to these questions have not been forthcoming. This is not surprising because ASTM standardization has not been applied to remote sensing or data telemetry as such, and the crossover into geotechnical applications carries with it all of the burdens of communications and cross-discipline competencies discussed earlier. To add to the challenge, the geotechnical field by itself poses special problems in standardization, primarily because of the intrinsic variability of the materials and environments encountered and because of the field conditions under which some of the standards are applied.

Is it logical and reasonable to conclude, then, that there is no place for ASTM standard practices or guides in the application of remote sensing or data telemetry to geotechnical work? Not at all. The fact that remote sensing signatures show a great deal of spread and that soil and rock are highly variable is all the more reason for seeking standards. The practical question to answer is this: where do we begin?

The logical place to start seems to be with the users—the geotechnical specialists. What are their needs? Through the process of successive iteration, it should be feasible to develop several precise statements of need. Existing committees within ASTM can provide the framework from which this process can begin. It's worth a try!

The papers presented in this volume will provide a useful reference both for those addressing the details of the standards issue and for others interested in sampling the work in a growing interdisciplinary field of great promise.