HYDROINFORMATICS

M.B. Abbott
International Institute for Hydraulic and Environmental Engineering (IHE), Delft, The Netherlands

Keywords: Hydraulics, hydroinformatics, hydraulic engineering, graphical interfacing, knowledge processors, numerical continuum, numerical modeling

Contents

Summary

The article gives an overview on the development of hydraulic and hydrologic information systems from early graphical and numerical databanks to present-day computer-driven networks. The various stages of development, keeping pace with the advent of more and more advanced computing technology and data storage and retrieval capacity, are outlined. A philosophical view is presented for dealing with information from the broadest to the most detailed methods for developing robust models for system analysis and prognosis.

1. Introduction

Hydroinformatics is the study of the flows of knowledge and data related to the flow of water and all that it transports, together with interactions with both the natural and the manmade, or artificial, environments. Hydraulics, understood as the study of flows of water, and more extended to include the transport of matter in all its forms within flows, is accordingly central to hydroinformatics. Without hydraulics there cannot be hydroinformatics.

It might at first appear as though hydroinformatics provides only a new periphery to hydraulics: a new way of transmitting hydraulics knowledge and data to society. In practice, however, the way in which hydraulics is viewed and practiced is itself changing as a result of its incorporation into the new paradigm that hydroinformatics provides. The first objective of this article is to introduce some of the changes that are proceeding in hydraulics under the influence of developments occurring in hydroinformatics. The second objective is to indicate the consequences of these changes for the direction of development of hydraulics itself (see *Fluid Mechanics*).

2. The Hydraulic Engineer in the Postsymbolic Era

The first and most obvious change that has occurred in hydraulic engineering is the way in which hydraulic engineers work. Like most other engineers, the hydraulic engineer, in large part, and in many cases for the most part, works through the graphical user interface of a computer and its associated network.

The era in which the engineer worked with symbols, making calculations directly from equations and the curves of the graphs of such equations, is mostly over. The engineer works mainly with signs. Whereas the symbols of an earlier era replaced the world in the mind of the engineer, at least while he or she manipulated these symbols, the signs of the graphical user interface point toward the world in the mind of the engineer (see *Measurement of Free-Surface Flow*).

More basically, while in the earlier era the engineer was a repository of knowledge made expressible in symbols, that is a knower, the engineer is now primarily a repository of the sum of all the means to access knowledge, so that he or she is primarily a consumer of knowledge made expressible in signs. Correspondingly, the device that was previously a computer, as a means of making computations, now becomes a knowledge processor, as a means of manipulating knowledge; and what was previously a data network, as a means merely of accessing data, now becomes an intranet, or even an extranet, as a device for communicating knowledge in the first place and data only in the second place. This new era, in which the engineer no longer works with symbols in the capacity of a knower, but instead works with signs in the capacity of a consumer of knowledge, is quite generally called the postsymbolic era (see *Probabilistic Methods and Stochastic Hydrology*).

3. Tool Builders and Tool Users

Corresponding to this change in the status of the engineer, and indeed in the status of all knowledge users, a division occurs between, on the one hand, those who produce, encapsulate, market, broker, and transmit knowledge and, on the other hand, those who access and use this knowledge. The equipment whereby knowledge is transferred belongs to the category of tools, so that one can identify here a division between tool builders and tool users.

Now, any theoretical discussion (let alone “a theory”) of this process of using equipment presents a special problem, which Heidegger long ago identified as follows:
The kind of being which equipment possesses—in which it manifests itself in its own right—can be called readiness-to-hand. Only because equipment has this “being-in-itself” and does not merely occur, is it manipulatable in the broadest sense and at our disposal. No matter how sharply one just looks at the “outward appearance” of things in whatever form this takes, one cannot discover anything ready-to-hand. If one looks at things just “theoretically,” one can get along without understanding readiness-to-hand.

But when dealing with them by using them and manipulating them, this activity is not a blind one; it has its own kind of sight by which one's manipulation is guided and from which it acquires its specific thingly character. Dealings with equipment subordinate themselves to the manifold assignments of the "in-order-to." And the sight with which they accommodate themselves is circumspection.

Thus, the interface across which almost all knowledge flows between the toolmaker and the tool user is one that functions most immediately, but then almost exclusively, through the faculty of sight, through the graphical user interface (GUI).

-
-
-

Bibliography

Abbott M.B. (1991). *Hydroinformatics: Information Technology and the Aquatic Environment*. Aldershot, UK: Avebury.

Abbott M.B. (1996). *The Sociotechnical Dimension of Hydroinformatics* (Proceedings of *Hydroinformatics 96*), ed. A. Müller. Rotterdam: Balkema.

Abbott M.B. (1998). New Business Opportunities, New Human Responsibilities. Proceedings of Hydroinformatics 98, ed. V.M. Babovic and L.C. Larsen. Rotterdam: Balkema. [Dealing with applications of hydroinformatics in a social and technological sense.]

Abbott M.B. (1999). Introducing Hydroinformatics. *Journal of Hydroinformatics* **I** (1), 3–19. [An updated formulation of the subject of hydroinformatics.]

Abbott M.B. and Dibike Y.B. (1998). On the Representation of Processes in the Hydroinformatics Era. Proceedings of Hydroinformatics 98, ed. V.M. Babovic and L.C. Larsen. Rotterdam: Balkema. [General guidelines for the practicing analyst.]

Abbott M.B. and Jonoski A. (1998). Promoting Collaborative Decisionmaking through Electronic Networking. Proceedings of Hydroinformatics 98, ed. V.M. Babovic and L.C. Larsen. Rotterdam: Balkema. [Methods for maximizing the benefits of networking techniques are given.]

Babovic V.M. and Abbott M.B. (1997). The Evolution of Equations from Hydraulic Data. *J. Hyd. Res.* **3**, 397–430. Delft: IAHR. [Review of the fundamental fluid mechanics principles as applied to data processing.]

Babovic V.M. and Larsen L.C. (1998). *Proceedings of Hydroinformatics 98.* Rotterdam: Balkema. [Describes data processing and calibration procedures, and many other such developments, involving deriving fully elaborated numerical schemes directly from data, instead of merely from continuum equations.]

Cunge J.A. (1998). *From Computational Hydraulics to Hydroinformatics.* Proceedings of the 3rd International Conference on Advances Hydro-Science and -Engineering, Brandenburg University, Cottbus, Germany, ed. K.P. Holtz, W. Bechteler, S.S.Y. Wang and M. Kawahara. [Review of the progress of *data processing* to *information theory*.]

Dibike Y.B. and Abbott M.B. (1998). The Symbolic Representation of Hydroinformatics Processes Using Elements of Category Theory. Proceedings of Hydroinformatics 98, ed. V.M. Babovic and L.C. Larsen. Rotterdam: Balkema.

Dibike Y.B., Minns A.W. and Abbott M.B. (1999). Applications of Artificial Neural Networks to the Generation of Wave Equations from Hydraulics Data. *J. Hyd. Res.* **1**, 81–98.

Heidegger M. (1927/1962). *Being and Time*, tr. J. Macquarrie and E. Robinson. London: Blackwell. [The philosophical origins of examining data and interpreting it to yield information.]

Holtz K.P., Bechteler W., Wang S.S.Y. and Kawahara M. (1999). Proceedings of the 3rd International Conference on Advances in Hydro-Science and -Engineering, Brandenburg Univerity, Cottbus, Germany, 320 pp., CD-ROM. University, MS: US: University of Mississippi, Center for Computational Hydroscience and Engineering. [Comprehensive overview of hydro-science and -engineering, including hydroinformatics development.]

Husserl E. (1938/1973). *Experience and Judgment*, tr. J.S. Churchill and K. Ameriks. London: Routledge. [Discusses weaknesses in earlier methods of data collection and interpretation.]

Jonoski A. and Abbott M.B. (1998). Network Distributed Decision Support Systems as Multiagent Constructs. Proceedings of Hydroinformatics 98, ed. V.M. Babovic and L.C. Larsen. [Discusses information communication as an important aid in data sharing.]

Thein K.N.N. and Abbott M.B. (1998). Internet-based Management of Water Resources for a New Burma. Proceedings of Hydroinformatics 98. Rotterdam: Balkema. [Current systems for worldwide sharing and interpretation of information are reviewed.]

Biographical Sketch

Michael Abbott is a specialist hydraulic and environmental research engineer who was responsible for the development of the science of hydroinformatics. He has developed scientifically based numerical computing programs for determining flow behavior in one to three dimensions and has applied this to consulting service practice dealing with complex flow problems and their analysis worldwide. He is associated with the IHE, the International Institute for Hydraulic and Environmental Engineering, situated in Delft, The Netherlands.