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Part 1

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Volume 1293

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INTRODUCTION

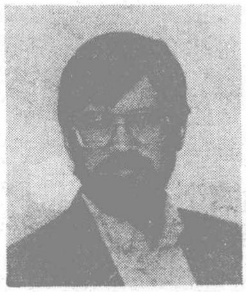
Mohan M. Trivedi
University of Tennessee/Knoxville

It is with great pleasure that I, on behalf of the program committee, welcome you to the Applications of Artificial Intelligence VIII conference. We have been organizing this annual event since 1984, and, as one can see from these proceedings, it has become a major forum for exchanging the latest ideas in the applied artificial intelligence field. The conference program includes participants from academia, government research laboratories, and industry. Also, in the last few years an increasing number of our international colleagues have been involved in the program. This diversity in the backgrounds of the participants provides a unique opportunity to examine and discuss technical ideas in formal as well as informal settings.

AI is now accepted as an important technology with significant scientific and commercial value. AI as a discipline has always attracted attention and debate. One of the issues discussed in these debates is that of the utility and contributions of this discipline. Our conference program provides a documentation of some of the tangible AI applications. Papers in the program highlight issues underlying a broad range of applications in real-world environments. The close scrutiny of our discipline is enforcing the practitioners in the field to justify the practical utility of the AI principles, tools, and techniques in non-trivial application domains. This is a refreshing trend.

The technical program for this year's conference includes 25 sessions and over 100 presentations. It also includes keynote addresses by three distinguished and active researchers in the field. On Tuesday, Professor Benjamin J. Kuipers will discuss Qualitative Reasoning and its Applications. Professor Bernard Widrow will talk about Control Applications for Neural Networks on Wednesday. The final plenary talk will be given by Professor Elliot Soloway on Highly Interactive Computing Environments.

Once again I welcome your participation in this conference. We hope that you will find the technical program stimulating, informative, and useful. Finally, it is my pleasure to acknowledge the assistance and contributions of the members of the program committee, of the authors, of the SPIE staff, and of Mrs. Janet Smith of the University of Tennessee.



Benjamin Kuipers

Use of qualitative simulation in support of model-based reasoning

Benjamin Kuipers received his B.A. degree in mathematics from Swarthmore College in 1970, did his graduate work at the MIT Artificial Intelligence Laboratory, and received a Ph.D. degree in mathematics from MIT in 1977.

He is now Associate Professor of Computer Sciences at the University of Texas at Austin. He has worked at Harvard University, Tufts University, and the Massachusetts Institute of Technology. His research interests are in various aspects of commonsense knowledge: qualitative reasoning with incomplete knowledge of physical mechanisms; resource-limited inference, and spatial exploration, learning, and problem solving.

Dr. Kuipers is a member of the Association for Computing Machinery, the American Association for the Advancement of Science, the American Association for Artificial Intelligence, IEEE, the Society for Values in Higher Education, and Computer Professionals for Social Responsibility.

Bernard Widrow

Truck backer-upper: an example of self-learning in neural networks

Bernard Widrow is a professor of electrical engineering at Stanford University. Before joining the Stanford faculty in 1959, he was with the Massachusetts Institute of Technology, Cambridge, Massachusetts. He is presently engaged in research and teaching of neural networks, pattern recognition, adaptive filtering, and adaptive control systems. He is associate editor of the journals *Adaptive Control and Signal Processing*, *Neural Networks*, *Information Sciences*, and *Pattern Recognition* and coauthor with S. D. Stearns of *Adaptive Signal Processing* (Prentice Hall).

(continued)

Dr. Widrow received S.B., S.M., and Sc.D. degrees from MIT in 1951, 1953, and 1956. He is a member of the American Association of University Professors, the Pattern Recognition Society, Sigma Xi, and Tau Beta Pi. He is a fellow of the IEEE and of the American Association for the Advancement of Science. He is the president of the International Neural Network Society. Dr. Widrow received the IEEE Alexander Graham Bell Medal in 1986 for exceptional contributions to the advancement of telecommunications.

Elliot Soloway

Highly interactive computing environments: the next wave

Elliot Soloway is an Associate Professor in the Department of Electrical Engineering and Computer Science at the University of Michigan. He joined the department in September of 1988, after spending seven years in the Computer Science Department at Yale University. Dr. Soloway is a member of the Artificial Intelligence Laboratory at the University.

Dr. Soloway's research interests weave together two broad areas: AI and software engineering, and AI and education. In the former, Dr. Soloway has brought a cognitively oriented perspective to understanding how software professionals carry out their tasks (design, testing, etc.). Drawing on that understanding, Dr. Soloway is developing both the theory and the curriculum materials (and computer-based support systems) to enable students to learn "synthesis skills" — building skills — by way of learning computer programming. Key to both areas, of course, is the role of collaboration in building complex artifacts such as software systems.

In order to gain access to real software projects, Dr. Soloway consults extensively to companies and government agencies such as IBM, DEC, and NASA/JPL. In order to assess the impact of his models of learning, Dr. Soloway teaches courses on software design at the university level as well as in high schools. He also plays an active role in the research community by founding and chairing workshops on empirical studies of programmers and editing the new journal of *AI & Education.*

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SESSION 1A

Computer Vision

Chair

Richard W. Conners
Virginia Polytechnic Institute and State University

Object detection using scale-space

V. Topkar, B. Kjell and A. Sood

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ABSTRACT

Scale-space representation is a topic of active research in computer vision. Most of the work so far has concentrated on image reconstruction from the scale-space representation. In this paper we discuss the use of scale-space representation for object detection. We have proposed a model based approach and developed an algorithm to implement it. Channel integration is the heart of the algorithm and there are a number of unresolved issues in it. Object detection is possible only if the objects of interest are different from the noise and clutter in certain features. We have used two different images, one with good signal to noise ratio and the other with poor signal to noise ratio In the first image the distinguishing feature of the object is its signal strength and in the second image it is its size. Accordingly we have studied two approaches to the channel integration : (i) based on the contrast value and (ii) based on edge focusing and splitting. The results of both approaches are presented and discussed.

1. INTRODUCTION

Object detection refers to the process of separating the objects (image contents of interest) in an image from the background (image contents of no interest). For example, in an aerial image of a town, one may be interested in finding houses. Hence the house becomes an object and the rest becomes the background. If one is interested in locating trees then the tree becomes an object and the rest (including the houses) becomes the background. Thus what is an object and what is background is a matter of definition dependent upon the application. However, to successfully separate the objects from the background, there must be some distinguishing features between the two. An object detection system typically extracts these distinguishing features as a first step. However features can not be extracted directly from the gray level image. Rather the image is first reduced by using techniques such as edge detection. Edge detection is important because the success of extracting features depends directly or indirectly on the performance of an edge detector.

Gradient based edge detectors are common. Typically the gradient of an image is computed at all pixels, and pixels having high values (above some threshold) of gradient are classified as edges. All real images are corrupted by noise and clutter. Noise is generally characterized as additive white Gaussian. Clutter is caused by the background elements and can be characterized as colored noise. In this paper we use the term noise to mean both the noise and clutter. Since the input noise is increased by differentiation, the image is first smoothed before computing the gradient. The Laplacian of Gaussian (LoG) operator is one such example in which the image is smoothed by a Gaussian filter and the peaks in the gradients are detected by detecting the zero crossings (z.c.s) of the second derivative of the image. The standard deviation of the Gaussian (σ) is called the scale of this operator which is an important parameter because it controls the amount of smoothing and hence the bandwidth of the operator. There are two major problems in using this operator: (i) If the scale of the operator is too large, neighboring edges interfere with each other causing delocalization,(ii) If the scale is too small, the noise is not filtered sufficiently giving rise to a large number of false alarms. Hence, selecting a proper scale for a given image is crucial for good performance. This, however, is almost impossible in practice because of insufficient *a priori* knowledge and because the proper scale value may be different for different parts of the same image.

The *multiscale* or the *scale-space* approach tries to overcome this drawback by using LoG filters of more than one scale and combining their outputs. This approach was proposed by Marr and Hildreth[1] and has been of considerable interest since then. The basic idea behind the scale-space approach can be summarized as follows : The image is passed through a bank of LoG filters (Fig. 2) each tuned to a different scale. The output of each filter is a set of zero crossing (z.c.) locations which are then plotted as a function of the scale value. This representation is called the *scale-space representation* and contains (for sufficiently large number of scale values) all the information about the input images[2-3]. The scale-space representation is then analyzed to detect edges or other features of interest.