Lecture Notes in Computer Science 588
Edited by G. Goos and J. Hartmanis

Advisory Board: W. Brauer D. Gries J. Stoer

G. Sandini (Ed.)

Computer Vision – ECCV '92

Second European Conference on Computer Vision
Santa Margherita Ligure, Italy, May 19-22, 1992
Proceedings

Springer-Verlag
Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona
Budapest

Series Editors

Gerhard Goos
Universität Karlsruhe
Postfach 69 80
Vincenz-Priessnitz-Straße 1
W-7500 Karlsruhe, FRG

Juris Hartmanis
Cornell University
Department of Computer Science
5149 Upson Hall
Ithaca, NY 14853, USA

Volume Editor

Giulio Sandini
Dept. of Communication, Computer, and Systems Science, University of Genova
Via Opera Pia, 11A, I-16145 Genova, Italy

CR Subject Classification (1991): I.3, I.5, I.2.9-10

ISBN 3-540-55426-2 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-55426-2 Springer-Verlag New York Berlin Heidelberg

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1992
Printed in Germany

Typesetting: Camera ready by author
Printing and binding: Druckhaus Beltz, Hemsbach/Bergstr.
45/3140-543210 - Printed on acid-free paper

Foreword

This volume collects the papers accepted for presentation at the Second European Conference on Computer Vision held in Santa Margherita Ligure, Italy, May 19 - 22, 1992.

The selection of the papers has been extremely difficult because of the high number and excellent quality of the papers submitted. I wish to thank my friends on the Programme Committee who, with the help of other qualified referees, have done a tremendous job in reviewing the papers at short notice.

In order to maintain a single-track conference, and to keep this book within a reasonable size, 16 long papers, 41 short papers and 48 posters have been selected from the 308 submissions, and structured into 14 sections reflecting the major research topics in computer vision currently investigated worldwide.

I personally would like to thank all the authors for the quality of their work and for their collaboration in keeping the length of the papers within the limits requested (we all know how painful it is to delete lines after they have been printed). Particular thanks to those who submitted papers from outside Europe for the credit given to the European computer vision community. Their contribution has been fundamental in outlining the current state of the art in computer vision and in producing further evidence of the maturity reached by this important research field. Thanks to ESPRIT and other collaborative projects the number of "transnational" (and even "transcontinental") papers is increasing, with political implications which outlast, to some extent, the scientific ones. It will be a major challenge for the computer vision community to take advantage of the recent political changes worldwide in order to bring new ideas into this challenging research field.

I wish to thank all the persons who contributed to make ECCV-92 a reality, in particular Piera Ponta of Genova Ricerche, Therese Bricheteau and Cristine Juncker of INRIA and Lorenza Luceti of DIST who helped in keeping things under control during the hot phases of the preparation.

I give special thanks to Olivier Faugeras, who, as a the chairman of ECCV-90, established the high standard of this conference, thus contributing significantly in attracting so many good papers to ECCV-92.

Finally let me thank Anna, Pietro and Corrado for their extra patience during these last months.

Genova, March 1992 Giulio Sandini

Chairperson

Giulio Sandini	DIST, University of Genova

Board

Bernard Buxton	GEC Marconi, Hirst Research Center
Olivier Faugeras	INRIA - Sophia Antipolis
Goesta Granlund	Linköping University
John Mayhew	Sheffield University
Hans H. Nagel	Karlsruhe University Fraunhofer Inst.

Programme Committee

Nicholas Ayache	INRIA Rocquencourt
Andrew Blake	Oxford University
Mike Brady	Oxford University
Hans Burkhardt	University Hamburg-Harburg
Hilary Buxton	Queen Mary and Westfield College
James Crowley	LIFIA - INPG, Grenoble
Rachid Deriche	INRIA Sophia Antipolis
Ernest Dickmanns	University München
Jan Olof Eklundh	Royal Institute of Technology, Stockholm
David Hogg	Leeds University
Jan Koenderink	Utrecht State University
Hans Knutsson	Linkoping University
Roger Mohr	LIFIA - INPG, Grenoble
Bernd Neumann	Hamburg University
Carme Torras	Institute of Cybernetics, Barcelona
Vincent Torre	University of Genova

Video Proceedings:

Giovanni Garibotto	Elsag Bailey S.p.a.

Experimental Sessions:

Massimo Tistarelli	DIST, University of Genova

ESPRIT Day Organization:

Patrick Van Hove	CEC, DG XIII

ESPRIT Workshops Coodination:

James L. Crowley	LIFIA - INPG, Grenoble

Coordination:

Piera Ponta	Consorzio Genova Ricerche
Cristine Juncker	INRIA, Sophia-Antipolis
Therese Bricheteau	INRIA
Lorenza Luceti	DIST, University of Genova
Nicoletta Piccardo	Eurojob, Genova

Referees

Amat J.	Spain
Andersson M.T.	Sweden
Aubert D.	France
Ayache N.	France
Bårman H.	Sweden
Bascle B.	France
Bellissant C.	France
Benayoun S.	France
Berger M.O.	France
Bergholm F.	Sweden
Berroir J.P.	France
Berthod M.	France
Besañez L.	Spain
Betsis D.	Sweden
Beyer H.	France
Blake A.	U.K.
Boissier O.	France
Bouthemy P.	France
Boyle R.	U.K.
Brady M.	U.K.
Burkhardt H.	Germany
Buxton B.	U.K.
Buxton H.	U.K.
Calean D.	France
Carlsson S.	Sweden
Casals A.	Spain
Castan S.	France
Celaya E.	Spain
Chamley S.	France
Chassery J.M.	France
Chehikian A.	France
Christensen H.	France
Cinquin Ph.	France
Cohen I.	France
Cohen L.	France
Crowley J.L.	France
Curwen R.	U.K.
Dagless E.	France
Daniilidis K.	Germany
De Micheli E.	Italy
Demazeau Y.	France
Deriche R.	France
Devillers O.	France
Dhome M.	France
Dickmanns E.	Germany
Dinten J.M.	France
Dreschler-Fischer L.	Germany
Drewniok C.	Germany
Eklundh J.O.	Sweden
Faugeras O.D.	France
Ferrari F.	Italy
Fossa M.	Italy
Fua P.	France
Gårding J.	Sweden
Garibotto G.	Italy
Giraudon G.	France
Gong S.	U.K.
Granlund G.	Sweden
Gros P.	France
Grosso E.	Italy
Gueziec A.	France
Haglund L.	Sweden
Heitz F.	France
Hérault H.	France
Herlin I.L.	France
Hoehne H.H.	Germany
Hogg D.	U.K.
Horaud R.	France
Howarth R.	U.K.
Hugog D.	U.K.
Hummel R.	France
Inglebert C.	France
Izuel M.J.	Spain
Juvin D.	France
Kittler J.	U.K.
Knutsson H.	Sweden
Koenderink I.	The Netherlands
Koller D.	Germany
Lange S.	Germany
Lapreste J.T.	France
Levy-Vehel J.	France
Li M.	Sweden
Lindeberg T.	Sweden
Lindsey P.	U.K.
Ludwig K.-O.	Germany
Luong T.	France
Lux A.	France
Magrassi M.	Italy
Malandain G.	France
Martinez A.	Spain
Maybank S.J.	France
Mayhew J.	U.K.
Mazer E.	France
Mc Lauchlan P.	U.K.
Mesrabi M.	France
Milford D.	France
Moeller R.	Germany
Mohr R.	France
Monga O.	France
Montseny E.	Spain
Morgan A.	France
Morin L.	France
Nagel H.H.	Germany
Nastar C.	France
Navab N.	France
Neumann B.	Germany
Neumann H.	Germany
Nordberg K.	Sweden
Nordström N.	Sweden
Olofsson G.	Sweden
Pahlavan K.	Sweden
Pampagnin L.H.	France
Papadopoulo T.	France
Paternak B.	Germany
Petrou M.	France
Puget P.	France
Quan L.	France
Radig B.	Germany
Reid I.	U.K.
Richetin M.	France
Rives G.	France
Robert L.	France
Sagerer G.	Germany
Sandini G.	Italy
Sanfeliu A.	Spain
Schroeder C.	Germany
Seals B.	France
Simmeth H.	Germany
Sinclair D.	U.K.
Skordas Th.	France
Sommer G.	Germany
Sparr G.	Sweden
Sprengel R.	Germany
Stein Th. von	Germany
Stiehl H.S.	Germany
Thirion J.P.	France
Thomas B.	France
Thomas F.	Spain
Thonnat M.	France
Tistarelli M.	Italy
Toal A.F.	U.K.
Torras C.	Spain
Torre V.	Italy
Trävén H.	Sweden
Uhlin T.	Sweden
Usoh M.	U.K.
Veillon F.	France
Verri A.	Italy
Vieville T.	France
Villanueva J.J.	Spain
Wahl F.	Germany
Westelius C.J.	Sweden
Westin C.F.	Sweden
Wieske L.	Germany
Wiklund J.	Sweden
Winroth H.	Sweden
Wysocki J.	U.K.
Zerubia J.	France
Zhang Z.	France

Organization and Support

Organized by:
DIST, University of Genova

In Cooperation with:
Consorzio Genova Ricerche
INRIA - Sophia Antipolis
Commission of the European Communities, DGXIII - ESPRIT

Supported by:
C.N.R. Special Project on Robotics
European Vision Society

Major Corporate Sponsor
Elsag Bailey S.p.a.

Corporate Sponsors
Digital Equipment Corporation - Italy
Sincon - Fase S.p.A. - Italy
Sun Microsystems - Italy

Contents

Features

Steerable-Scalable Kernels for Edge Detection and Junction Analysis 3
P.Perona

Families of Tuned Scale-Space Kernels 19
L.J.Florack, B.M.ter Haar Romeny, J.J.Koenderink, M.A.Viergever

Contour Extraction by Mixture Density Description Obtained from Region Clustering 24
M.Etoh, Y.Shirai, M.Asada

The Möbius Strip Parameterization for Line Extraction 33
C.-F.Westin, H.Knutsson

Edge Tracing in a priori Known Direction 38
A.Nowak, A.Florek, T.Piascik

Features Extraction and Analysis Methods for Sequences of Ultrasound Images 43
I.L.Herlin, N.Ayache

Figure-Ground Discrimination by Mean Field Annealing 58
L.Hérault, R.Horaud

Deterministic Pseudo-Annealing: Optimization in Markov-Random-Fields An Application to Pixel Classification 67
M.Berthod, G.Giraudon, J.P.Stromboni

A Bayesian Multiple Hypothesis Approach to Contour Grouping 72
I.J.Cox, J.M.Rehg, S.Hingorani

Detection of General Edges and Keypoints 78
L.Rosenthaler, F.Heitger, O.Kübler, R.von der Heydt

Distributed Belief Revision for Adaptive Image Processing Regulation 87
V.Murino, M.F.Peri, C.S.Regazzoni

Finding Face Features 92
I.Craw, D.Tock, A.Bennett

Color

Detection of Specularity Using Color and Multiple Views 99
S.W.Lee, R.Bajcsy

Data and Model-Driven Selection Using Color Regions 115
T.F.Syeda-Mahmood

Recovering Shading from Color Images 124
B.V.Funt, M.S.Drew, M.Brockingston

Texture and Shading

Shading Flows and Scenel Bundles: A New Approach to Shape from Shading ... 135
P.Breton, L.A.Iverson, M.S.Langer, S.W.Zucker

Texture: Plus ça Change,.... ... 151
M.M.Fleck

Texture Parametrization Method for Image Segmentation ... 160
A.Casals, J.Amat, A.Grau

Texture Segmentation by Minimizing Vector-Valued Energy Functionals:
The Coupled-Membrane Model ... 165
T.S.Lee, D.Mumford, A.Yuille

Boundary Detection in Piecewise Homogeneous Textured Images ... 174
S.Casadei, S.Mitter, P.Perona

Motion Estimation

Surface Orientation and Time to Contact from Image Divergence and Deformation .. 187
R.Cipolla, A.Blake

Robust and Fast Computation of Unbiased Intensity Derivates in Images ... 203
T.Vieville, O.D.Faugeras

Testing Computational Theories of Motion Discontinuities:
A Psychophysical Study ... 212
L.M.Vaina, N.M.Grzywacz

Motion and Structure Factorization and Segmentation of Long Multiple
Motion Image Sequences ... 217
C.Debrunner, N.Ahuja

Motion and Surface Recovery Using Curvature and Motion Consistency ... 222
G.Soucy, F.P.Ferrie

Finding Clusters and Planes from 3D Line Segments with Application to 3D
Motion Determination ... 227
Z.Zhang, O.D.Faugeras

Hierarchical Model-Based Motion Estimation ... 237
J.R.Bergen, P.Anandan, K.J.Hanna, R.Hingorani

A Fast Method to Estimate Sensor Translation ... 253
V.Sundareswaran

Identifying Multiple Motions from Optical Flow ... 258
A.Rognone, M.Campani, A.Verri

A Fast Obstacle Detection Method Based on Optical Flow ... 267
N.Ancona

A Parallel Implementation of a Structure-from-Motion Algorithm ... 272
H.Wang, C.Bowman, M.Brady, C.Harris

Structure from Motion Using the Ground Plane Constraint ... 277
T.N.Tan, G.D.Sullivan, K.D.Baker

Detecting and Tracking Multiple Moving Objects Using Temporal Integration 282
M.Irani, B.Rousso, S.Peleg

Calibration and Matching

A Study of Affine Matching with Bounded Sensor Error 291
W.E.L.Grimson, D.P.Huttenlocher, D.W.Jacobs

Epipolar Line Estimation 307
S.I.Olsen

Camera Calibration Using Multiple Images 312
P.Beardsley, D.Murray, A.Zisserman

Camera Self-Calibration: Theory and Experiments 321
O.D.Faugeras, Q.-T.Luong, S.J.Maybank

Model-Based Object Pose in 25 Lines of Code 335
D.F.DeMenthon, L.S.Davis

Depth

Image Blurring Effects due to Depth Discontinuities:
Blurring that Creates Emergent Image Details 347
T.C.Nguyen, T.S.Huang

Ellipse Based Stereo Vision 363
J.Buurman

Applying Two-Dimensional Delaunay Triangulation to Stereo Data Interpretation .. 368
E.Bruzzone, M.Cazzanti, L.De Floriani, F.Mangili

Local Stereoscopic Depth Estimation Using Ocular Stripe Maps 373
K.-O.Ludwig, H.Neumann, B.Neumann

Depth Computations from Polyhedral Images. 378
G.Sparr

Parallel Algorithms for the Distance Transformation 387
H.Embrechts, D.Roose

Stereo-motion

A Computational Framework for Determining Stereo Correspondence from
a Set of Linear Spatial Filters 395
D.G.Jones, J.Malik

On Visual Ambiguities due to Transparency in Motion and Stereo 411
M.Shizawa

A Deterministic Approach for Stereo Disparity Calculation 420
C.Chang, S.Chatterjee

Occlusions and Binocular Stereo 425
D.Geiger, B.Ladendorf, A.Yuille

Tracking

Model-Based Object Tracking in Traffic Scenes 437
D.Koller, K.Daniilidis, T.Thórhallsson, H.-H.Nagel

Tracking Moving Contours Using Energy-Minimizing Elastic Contour Models 453
N.Ueda, K.Mase

Tracking Points on Deformable Objects Using Curvature Information 458
I.Cohen, N.Ayache, P.Sulger

An Egomotion Algorithm Based on the Tracking of Arbitrary Curves 467
E.Arbogast, R.Mohr

Region-Based Tracking in an Image Sequence 476
F.Meyer, P.Bouthemy

Combining Intensity and Motion for Incremental Segmentation and Tracking over Long Image Sequences 485
M.J.Black

Active Vision

Active Egomotion: A Qualitative Approach 497
Y.Aloimonos, Z.Duriç

Active Perception Using DAM and Estimation Techniques 511
W.Pölzleitner, H.Wechsler

Active-Dynamic Stereo for Navigation 516
E.Grosso, M.Tistarelli, G.Sandini

Integrating Primary Ocular Processes 526
K.Pahlavan, T.Uhlin, J.-O.Eklundh

Where to Look Next Using a Bayes Net: Incorporating Geometric Relations 542
R.D.Rimey, C.M.Brown

An Attentional Prototype for Early Vision 551
S.M.Culhane, J.K.Tsotsos

Binocular Heads

What Can Be Seen in Three Dimensions with an Uncalibrated Stereo Rig? 563
O.D.Faugeras

Estimation of Relative Camera Positions for Uncalibrated Cameras 579
R.I.Hartley

Gaze Control for a Binocular Camera Head 588
J.L.Crowley, P.Bobet, M.Mesrabi

Curved Surfaces and Objects

Computing Exact Aspect Graphs of Curved Objects: Algebraic Surfaces 599
J.Ponce, S.Petitjean, D.J.Kriegman

Surface Interpolation Using Wavelets 615
A.P.Pentland

Smoothing and Matching of 3D Space Curves 620
A.Guéziec, N.Ayache

Shape from Texture for Smooth Curved Surfaces 630
J.Gårding

Recognizing Rotationally Symmetric Surfaces from Their Outlines 639
D.A.Forsyth, J.L.Mundy, A.Zisserman, C.A.Rothwell

Using Deformable Surfaces to Segment 3D Images and Infer Differential Structures .. 648
I.Cohen, L.D.Cohen, N.Ayache

Finding Parametric Curves in an Image 653
A.Leonardis, R.Bajcsy

Reconstruction and Shape

Determining Three-Dimensional Shape from Orientation and Spatial Frequency Disparities 661
D.G.Jones, J.Malik

Using Force Fields Derived from 3D Distance Maps for Inferring the Attitude of a 3D Rigid Object 670
L.Brunie, S.Lavallée, R.Szeliski

Segmenting Unstructured 3D Points into Surfaces 676
P.Fua, P.Sander

Finding the Pose of an Object of Revolution 681
R.Glachet, M.Dhome, J.T.Lapreste

Extraction of Line Drawings from Gray Value Images by Non-Local Analysis of Edge Element Structures 687
M.Otte, H.-H.Nagel

A Method for the 3D Reconstruction of Indoor Scenes from Monocular Images .. 696
P.Olivieri, M.Gatti, M.Straforini, V.Torre

Active Detection and Classification of Junctions by Foveation with a Head-Eye System Guided by the Scale-Space Primal Sketch 701
K.Brunnström, T.Lindeberg, J.-O.Eklundh

A New Topological Classification of Points in 3D Images 710
G.Bertrand, G.Malandain

A Theory of 3D Reconstruction of Heterogeneous Edge Primitives from Two Perspective Views 715
M.Xie, M.Thonnat

Detecting 3D Parallel Lines for Perceptual Organization 720
X.Lebègue, J.K.Aggarwal

Integrated Skeleton and Boundary Shape Representation for Medical Image Interpretation 725
G.P.Robinson, A.C.F.Colchester, L.D.Griffin, D.J.Hawkes

Critical Sets for 3D Reconstruction Using Lines 730
Th.Buchanan

Intrinsic Surface Properties from Surface Triangulation 739
X.Chen, F.Schmitt

Edge Classification and Depth Reconstruction by Fusion of Range and Intensity Edge Data 744
G.Zhang, A.Wallace

Image Compression and Reconstruction Using a 1D Feature Catalogue 749
B.Y.K.Aw, R.A.Owens, J.Ross

Recognition

Canonical Frames for Planar Object Recognition 757
C.A.Rothwell, A.Zisserman, D.A.Forsyth, J.L.Mundy

Measuring the Quality of Hypotheses in Model-Based Recognition 773
D.P.Huttenlocher, T.A.Cass

Using Automatically Constructed View-Independent Relational Model in 3D Object Recognition 778
S.Zhang, G.D.Sullivan, K.D.Baker

Learning to Recognize Faces from Examples 787
S.Edelman, D.Reisfeld, Y.Yeshurun

Face Recognition Through Geometrical Features 792
R.Brunelli, T.Poggio

Fusion Through Interpretation 801
M.J.L.Orr, J.Hallam, R.B.Fisher

3D Object Recognition Using Passively Sensed Range Data 806
K.M.Dawson, D.Vernon

Interpretation of Remotely Sensed Images in a Context of Multisensor Fusion 815
V.Clément, G.Giraudon, S.Houzelle

Limitations of Non Model-Based Recognition Schemes 820
Y.Moses, S.Ullman

Constraints for Recognizing and Locating Curved 3D Objects from Monocular Image Features 829
D.J.Kriegman, B.Vijayakumar, J.Ponce

Polynomial-Time Object Recognition in the Presence of Clutter, Occlusion, and Uncertainty 834
T.A.Cass

Hierarchical Shape Recognition Based on 3D Multiresolution Analysis 843
S.Morita, T.Kawashima, Y.Aoki

Object Recognition by Flexible Template Matching Using Genetic Algorithms 852
A.Hill, C.J.Taylor, T.Cootes

Matching and Recognition of Road Networks from Aerial Images 857
S.Z.Li, J.Kittler, M.Petrou

Applications

Intensity and Edge-Based Symmetry Detection Applied to Car-Following 865
T.Zielke, M.Brauckmann, W.von Seelen

Indexicality and Dynamic Attention Control in Qualitative Recognition of Assembly Actions 874
Y.Kuniyoshi, H.Inoue

Real-Time Visual Tracking for Surveillance and Path Planning 879
R.Curwen, A.Blake, A.Zisserman

Spatio-Temporal Reasoning Within a Traffic Surveillance System 884
A.F.Toal, H.Buxton

Template Guided Visual Inspection 893
A.Noble, V.D.Nguyen, C.Marinos, A.T.Tran, J.Farley, K.Hedengren, J.L.Mundy

Hardware Support for Fast Edge-Based Stereo 902
P.Courtney, N.A.Thacker, C.R.Brown

Author Index 907