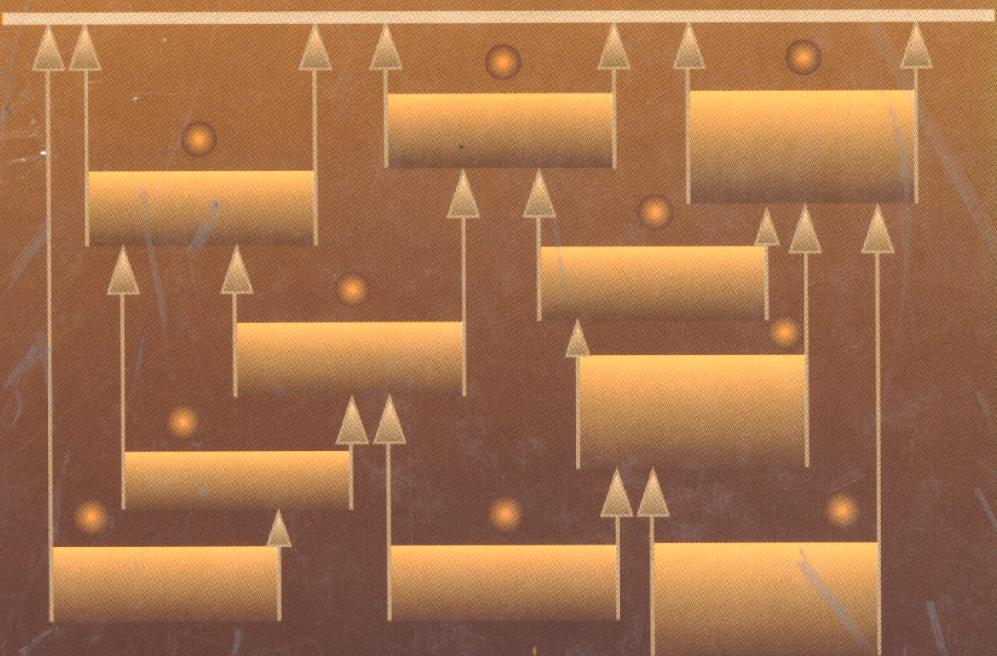


*Proceedings of the*  
*Computer Graphics International 1994 (CGI94)*

# INSIGHT THROUGH COMPUTER GRAPHICS

*editors*

**M Gigante**  
**T L Kunii**



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## Preface

Computer graphics has been advancing to the level of creating completely new worlds inside computers. Through such computer graphics worlds, we human beings now have far improved insight into wide varieties of real worlds starting from fairly simple but exact worlds of curves and surfaces and reaching to complex human worlds. This volume presents a concrete and advanced methods, techniques, modeling and mathematical backgrounds of the 12th Computer Graphics International (CGI94) held at Royal Melbourne Institute of Technology, Melbourne, Australia organized jointly with Computer Graphics Society (CGS), June 27–July 1, 1994, with emphasis on the applicability development of computer graphics based on the mathematical modeling of 3-dimensional shapes and complex phenomena. All research papers presented in this volume were referred and covered both the foundations and advances of computer graphics to increase the human visual insight of varieties of worlds.

Indeed, at the turning point of the century, the value of the advanced knowledge of computer graphics to visually present the complexity is ever increasing. As almost only annual conference series geographically going around the entire globe, Computer Graphics International (CGI) is also a vital media to promote researches in computer graphics internationally.

The editors wish to thank Professor David F. Rogers for co-chairing CGI94. Thanks also go to Royal Melbourne Institute of Technology and to Aizu Area Foundation for Promotion of Education and Science directed by Mr. Atsuyasu Takagi for making the publication of this book possible through financial support. Assistance of Professor Yuko Kesen and Professor Kazuaki Yamauchi of Office for Planning and Management of the University of Aizu in compiling the volume is deeply appreciated.

*April 1996*

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Open and refereed membership journals:

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