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Preface

It is with great pleasure that we welcome you to the proceedings of the 16th International Symposium on Visual Computing (ISVC 2021), which was held virtually (October 4–6, 2021). ISVC provides a common umbrella for the four main areas of visual computing including vision, graphics, visualization, and virtual reality. The goal is to provide a forum for researchers, scientists, engineers, and practitioners throughout the world to present their latest research findings, ideas, developments, and applications in the broader area of visual computing.

This year, the program consisted of six keynote presentations, 11 oral sessions, two poster sessions, and three special tracks. We received close to 135 submissions for the main symposium from which we accepted 48 papers for oral presentation and 32 papers for poster presentation. A total of nine papers were accepted for oral presentation in the special tracks from 15 submissions.

All papers were reviewed with an emphasis on the potential to contribute to the state of the art in the field. Selection criteria included accuracy and originality of ideas, clarity and significance of results, and presentation quality. The review process was quite rigorous, involving three independent blind reviews followed by several days of discussion. During the discussion period we tried to correct anomalies and errors that might have existed in the initial reviews. Despite our efforts, we recognize that some papers worthy of inclusion may have not been included in the program. We offer our sincere apologies to authors whose contributions might have been overlooked.

We wish to thank everybody who submitted their work to ISVC 2021 for review. It was because of their contributions that we succeeded in having a technical program of high scientific quality. In particular, we would like to thank the keynote speakers, the program chairs, the steering committee, the international Program Committee, the special track organizers, the tutorial organizers, the reviewers, the sponsors, and especially, the authors who contributed their work to the symposium. We would like to express our appreciation to Springer for sponsoring the “best” paper award again this year and to Vzense for being a bronze sponsor.

Despite all the difficulties due to the pandemic, we sincerely hope that ISVC 2021 offered participants opportunities for professional growth.

September 2021

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Tian Yuan	Innopeak Tech Inc
Torsney-Weir Thomas	VRVis
Tozal Mehmet Engin	University of Louisiana at Lafayette
Tubaro Stefano	Politecnico di Milano
Umlauf Georg	Universityof Applied Science Constance
Ushizima Daniela	Lawrence Berkeley National Laboratory
Viriri Serestina	University of KwaZulu-Natal
Voulodimos Athanasios	University of West Attica
Wang Cuilan	Georgia Gwinnett College
Wang Chaoli	University of Notre Dame
Weyers Benjamin	Trier University
Wischgoll Thomas	Wright State University
Wong Kin Hong	The Chinese University of Hong Kong
Xu Wei	Brookhaven National Lab
Yanagida Yasuyuki	Meijo University
Yang Xiaosong	Bournemouth University
Yang Fumeng	Brown University
Yen Hsu-Chun	National Taiwan University
Yin Lijun	State University of New York at Binghamton
Yu Zeyun	University of Wisconsin-Milwaukee
Yuan Chunrong	Technische Hochschule Köln
Zabulis Xenophon	FORTH
Zara Jiri	Czech Technical University in Prague
Zeng Wei	Florida International University
Zhao Jian	University of Waterloo
Zhu Ying	Georgia State University

Keynote Talks

Embodied Perception in-the-Wild

Deva Ramanan

Carnegie-Mellon University, USA

Abstract. Computer vision is undergoing a period of rapid progress, rekindling the relationship between perception, action, and cognition. Such connections may be best practically explored in the context of autonomous robotics. In this talk, I will discuss perceptual understanding tasks motivated by embodied "in-the-wild" autonomous robots, focusing on the illustrative case of autonomous vehicles. I will argue that many challenges that surface are not well-explored in contemporary computer vision. These include streaming perception with bounded resources, generalization via spatiotemporal grouping, rethinking the interface between perception and action, and robust processing that can recognize anomalous out-of-sample events. I will conclude with a description of open challenges for embodied perception in-the-wild.

Design Tools for Material Appearance

Holly Rushmeier

Yale University, USA

Abstract. The design of material appearance for both virtual and physical design remains a challenging problem. There aren't straightforward intuitive techniques as there are in geometric design where shapes can be sketched or assembled from geometric primitives. In this talk I will present a series of contributions to developing intuitive appearance design tools. This includes studies of material appearance perception which form the basis of the development of perceptual axes for reflectance distribution design. I will also present novel interfaces for design including hybrid slider/image navigation and augmented reality interfaces. I will discuss the unique problems involved in designing appearance for objects to be physically manufactured rather than simply displayed in virtual environments. Finally, I will show how exemplars of spatially varying materials can be inverted to produce procedural models.

Guidance-Enriched Visual Analytics: Challenges and Opportunities

Silvia Miksch

TU Wien, Austria

Abstract. On the one hand, we investigate appropriate, expressive, and effective Visual Analytics concepts and solutions for particular users, their data, and their tasks in mind. On the other hand, we explore the usage and potential of guidance. Guidance aims to support the user while working with Visual Analytics solutions. Guidance assists users with the selection of appropriate visual means and interaction techniques, the utilization of analytical methods, as well as the configuration instantiation of these algorithms with suitable parameter settings and the combinations thereof. After a visualization or Visual Analytics method and parameters are selected, guidance is also needed to explore the data, identify interesting data nuggets and findings, collect and group insights to explore high level hypotheses, and gain new insights and knowledge. In this talk, I will contextualize the different aspects of guidance-enriched Visual Analytics. I will present a framework for guidance designers which comprising requirements, a set of specific phases with quality criteria designers should go through when designing guidance-enriched Visual Analytics. Various examples will illustrate what has been achieved so far and show possible future directions and challenges.

Learning and Accruing Knowledge over Time Using Modular Architectures

Marc'Aurelio Ranzato

Facebook AI Research, USA

Abstract. A typical trait of any intelligent system is the ability to learn new skills quickly without too many interactions with a teacher. Over time we also would expect an intelligent system to become better at solving new tasks, coming up with a better solution in even less time if the new task relates to something already learned in the past. While nowadays machine learning methods excel at learning a single task from large amounts of labeled data, and more recently, even from little labeled data provided suitable pretraining on a vast amount of unlabeled data, knowledge is seldom accrued over time. Whenever more data and compute are available, bigger models are often retrained from scratch. In this talk, I argue that by considering the sequence of learning tasks, and more generally, the sequential nature of the data acquisition process, we may grant our artificial learners an unprecedented opportunity to transfer knowledge and even accrue knowledge over time, potentially leading to more efficient and effective learning of future tasks. From the modeling side, I will introduce a few variants of hierarchical mixtures of experts, which are deep modular networks. These architectures are appealing for a twofold reason. First, since they are modular it is natural to add modules over time to accommodate the acquisition of new knowledge. The modularity also leads to computational efficiency since run time can be made constant with respect to the number of modules. Second, by recombining modules in novel ways compositional generalization emerges, yielding learners that learn faster as time goes by. I will demonstrate these ideas on several learning settings applied to vision, namely compositional 0-shot learning, continual learning and anytime learning. Although these are admittedly baby steps towards our grand goal, I believe there is an untapped potential for more effective and efficient learning once we frame learning as a life-long learning experience.

Combining Brain-Computer Interfaces and Virtual Reality: Novel 3D Interactions and Promising Applications

Anatole Lécuyer

Inria, France

Abstract. In this talk I will present a research path on Brain-Computer Interfaces (BCI) aiming to establish a solid connection with Virtual Reality (VR) and Augmented Reality (AR). I will first evoke the great success of OpenViBE, an open-source software platform dedicated to BCI research used today all over the world, notably with VR systems. Then, I will illustrate how BCI and VR/AR technologies can be combined to design novel 3D interactions and effective applications, e.g. for health, sport, entertainment, or training.

Direct Estimation of Appearance Models for Image Segmentation

Pedro Felzenszwalb

Brown University, USA

Abstract. Image segmentation algorithms often depend on appearance models that characterize the distribution of pixel values in different image regions. We describe a novel approach for estimating appearance models directly from an image, without explicit consideration of the pixels that make up each region. Our approach is based on algebraic expressions that relate local image statistics to the appearance models of spatially coherent regions. The approach leads to two different algorithms for estimating appearance models. We present experimental results that demonstrate the proposed methods work well in practice and lead to effective image segmentation algorithms.

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Applications

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Computer Graphics II

3D Vision

Virtual Reality

Motion and Tracking

Object Detection and Recognition

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