OpenLabNight 2019

Programm - Mittwoch, 2. Okt.

Inffeldgasse 16/2

Inffeldgasse 16 c /2
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<th>Industrial Augmented Reality</th>
<th>Learning &amp; Recognition</th>
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| Clemens Arth and his team present accurate 3D sensing of the environment and novel human-computer interaction using augmented reality in industrial use cases. They demonstrate examples of improved and efficient collaboration in augmented reality. | Horst Bischof and his team present recent work on autonomous driving and recognition of human motions and activities.  
- **Computer Vision for Autonomous Driving**  
- **Human Motion Analysis**  
- **Autonomous Golfing** | Darko Stern and his team present recent work in machine learning and image analysis algorithms with the focus on medical image analysis.  
- **Sparse-view CT reconstruction using deep learning**  
- **Segmentation and tracking of cells in microscopic images** |

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| Friedrich Fraundorfer and his team show research results in the area of 3D computer vision and demonstrate the camera drones used the aerial vision lab. | Vincent Lepetit and his team are concerned with computer vision for AR. The main research topics covered are 3D object detection and tracking, 3D pose estimation, and scene understanding:  
- **3D room layout estimation**  
- **Hand pose estimation** | Denis Kalkofen and his team present novel approaches for mixed reality displays.  
- **Light field annotations**  
- **Light field display**  
- **Virtual reality in mining education**  
- **Animated reality** |

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| Thomas Pock and his team show how to solve challenging computer vision and image processing problems using variational methods and machine learning.  
- **Image inpainting with generative prior**  
- **Sub-pixel accurate stereo reconstruction**  
- **Face-to-face morphing** | Dieter Schmalstieg and his team show novel algorithms and display technologies for Virtual Reality.  
- **Shading atlas streaming**  
- **Potentially visible set estimation**  
- **Instant avatar reconstruction**  
- **Virtual reality with eye tracking**  
- **Virtual reality with ultra-wide field of view** | Markus Steinberger and his team demonstrate real-time graphics, modeling and other 3D applications running in real time on the GPU.  
- **Dynamic on surface field editing for 3D printing**  
- **Real-time global illumination with stochastic lightcuts and deep-learning denoising**  
- **A high-performance software rendering pipeline for the GPU**  
- **Efficient subdivision surfaces on the GPU** |

| Medical Visualization | | |
|-----------------------|| |
| Jan Egger and his team show applications of visual computing in medical surgery planning.  
- **HoloLens for head and neck surgery planning**  
- **Automatic cranial implant reconstruction using deep learning** | | |
Industrial Augmented Reality

- Maintenance Interface on HoloLens (Philipp Fleck)
  You are going to repair a PC with Augmented Reality. We prepared step-by-step repair instruction supported with 3D models on the Hololens. Furthermore, an industrial user interface with live telemetry data streamed from the internet of things can be experienced. Video-calls will be possible as well.

- Wide Area Image Recognition (David Schögler)
  We will show augmented images covering the entire institute grounds. Utilizing ARCore on Android and our light-weight mobile visual search engine, you can explore billboards coming alive with augmentations.

Robotics and 3D

- Camera Drone Applications (Jesus Pestana)
  Come visit our display of camera drones. Our projects range from 3D reconstruction to delivery drones and inspection drones. Do you have a drone project idea that you want to develop? Pass by and let's discuss the future of robotics.

- Mobile 3D reconstructions (Rafael Weilharter)
  A huge bottleneck when it comes to 3D reconstruction is processing power. Here, we show how you can digitally recreate your room with computer vision algorithms running on a laptop. Furthermore, we are looking into ways to reconstruct larger outdoor scenes using drones.

- Satellite Image Analytics (Stefano Zorzi)
  Artificial intelligence allows analyzing and map cities from satellite images by automatic building and road detection. Can we train an eye in the sky? Come to visit us if you want to know more.

- Reconstructing the world from above (Ludwig Mohr)
  We create 3D models of cities from aerial and satellite imagery. View and compare models with different levels of detail originating from different data sources. Visit cities all around the world - from Austria over the Americas to Afghanistan.

Medical Visualization

- HoloLens for Head and Neck Surgery (Christina Gsaxner)
  In head and neck surgery, physicians can benefit from augmented reality (AR) in preparing and executing treatment. AR provides a more intuitive mental mapping from 3D imaging data to the patient. We have developed a system allowing physicians wearing an untethered augmented reality headset, the Microsoft HoloLens, to see visualizations precisely overlaid on the patient. By exploiting facial features, we register image data to the patient fully automatically and without markers, making our system comfortable and easy to use.

- Automatic Cranial Implant Reconstruction Using Deep Learning (Jianning Li)
  Fast and fully automatic design of 3D printed patient-specific cranial implant is highly desired in cranioplasty. To this end, various deep learning-based approaches are investigated. To facilitate supervised training, a database containing 200 high-resolution healthy CT skulls acquired in clinical routine is constructed. Due to the unavailability of large number of defected skulls from clinic, artificial defects are introduced to simulate that caused in a real cranial surgery. The sparsity of the binary voxel representation of the 3-D skull data is exploited to accelerate training and enable high resolution network input while maintaining low GPU Memory requirement.
Virtual Reality

- **Shading Atlas Streaming (Jörg Müller)**
  Shading atlas streaming is a novel split-rendering approach where a powerful server renders game graphics, which are then transmitted over the air to a wireless client, namely a virtual reality headset. The headset has its own mobile graphics processor and uses it to generate the final stereo image pair for virtual reality display. The main novelty is that the server renders to an object-space representation, the shading atlas, which is an efficient data structure to organize rendering results.

- **Potentially Visible Set Generation Using Trim Regions (Philip Voglreiter)**
  From-region potentially visible sets (PVS) are an important tool for rendering acceleration. Normally they are precomputed, but we demonstrate a method to generate PVS online for dynamic scenes and streaming rendering. We present the concept of rim regions to generate PVS efficiently. By applying this algorithm, we are not only capable of detecting intra-object self-disocclusions, but also handle both indoor and outdoor scenes equally well. Furthermore, our approach is suitable for animated objects, since no complex preprocessing is required. We show that the potentially visible sets we generate are tight for the given view cell and that the performance is high enough for practical use.

- **Instant Avatar (Philipp Grasmug)**
  We present a system for creating photorealistic 3D avatars by casually scanning a person with a smartphone. The resulting model can be rendered on a mobile device, such as a smartphone, in real time, including view-dependent texture mapping for high realism in difficult areas such as face or hair.

- **Virtual Reality with Eye Tracking (Ana Stanescu)**
  Humans can see over 180 degrees in their horizontal field of view. Current virtual reality headsets typically have around 100 degrees field of view, lacking in visual periphery. The Pimax 5K headset covers full 180 degrees. It allows running experiments with displaying images in the periphery. Moreover, it is just amazing to try!

- **Ultra-Wide Field of View Virtual Reality (Thomas Neff)**
  Humans can see over 180 degrees in their horizontal field of view. Current virtual reality headsets typically have around 100 degrees field of view, lacking in visual periphery. The Pimax 5K headset covers full 180 degrees. It allows running experiments with displaying images in the periphery. Moreover, it is just amazing to try!

Learning & Recognition

- **Computer Vision for Autonomous Driving (Georg Krispel, David Schinagl)**
  We present different applications for autonomous driving, including mobile mapping, semantic/instance segmentation, lane following and 3D object detection.

- **Human Motion Analysis (Horst Possegger)**
  Stop by for a game of Tetris and to find out more about our projects on video-based understanding of human motion.

- **Autonomous Golfing (Georg Krispel, Michael Opitz, Horst Possegger)**
  This demo shows how easily toys can be automated by computer vision.
Medical Imaging
- **Sparse-view CT Reconstruction using Deep Learning (Franz Thaler, Darko Stern)**
  Computed tomography (CT) is a non-invasive image modality to visualize the interior body structure, enabling the fast acquisition and high image quality; however, it utilizes ionizing radiation. As the risk of cancer is increased by radiation exposure, we developed a deep learning method to decrease the radiation dose.

- **Segmentation and Tracking of Cells in Microscopic Images (Christian Payer, Darko Stern)**
  Unlike semantic segmentation, instance segmentation assigns unique labels to each individual instance of the same object class. We will present a recurrent fully convolutional network architecture developed at ICG for tracking such instance segmentations over time, which is highly relevant, e.g., in biomedical applications involving cell growth and migration.

Mixed Reality
- **Light Field Annotations (Peter Mohr)**
  Remote assistance represents an important use case for mixed reality. With the rise of handheld and wearable devices, remote assistance has become practical in the wild. However, spontaneous provisioning of remote assistance requires an easy, fast and robust approach for capturing and sharing of unprepared environments. In this work, we make a case for utilizing interactive light field photography for remote assistance. We demonstrate the advantages of object representation using light fields over conventional geometric reconstruction. Moreover, we introduce a novel interaction method for annotating light fields in 3D space without requiring surface geometry to anchor annotations.

- **Light Field Display (Christoph Ebner)**
  While commercial VR headsets are capable of providing binocular depth cues, Displays with correct or near-correct focal cues are still a topic of research. For example, multi-layer light field displays aim to reproduce a 4D light field to the viewer using two or more stacked LCD panels.
  While this allows to drive both the vergence and the accommodation of the eyes, state-of-the-art displays suffer from computational overhead introduced by the large amount of data. Therefore, light field displays commonly present only simple virtual scenes.
  To support more realistic VR content, we present an end-to-end system for capturing and rendering varifocal video, enabling cinematic VR experiences that provide focus cues. Our system is capable of capturing varifocal video data and rendering light field attenuation layers from it in real time.

- **Virtual Reality in Mining Education (Shohei Mori)**
  We present an interactive Virtual Reality system for teaching mining students. Our system consists of a teacher and a student interface, enabling interactive instructions and cinematic VR presentations of exhaustion and evacuation processes in a surface mine.

- **Animated Reality (David Mandl)**
  We present an interactive system that can remove a real object from a scene and replace it with a virtual copy that is animated and lit by the environment. This poses many interesting challenges like 3D registration & tracking, inpainting, light estimation and visual coherence.
Real-Time-Graphics

• Dynamic on Surface Field Editing for 3D Printing (Pascal Stadlbauer)
  Geometric methods aiming at partitioning surface meshes have many applications: One is 3D printing of natural tessellations, reduced material printing, and printing models that do not fit in a 3D printer as a whole. We show that geometric partitions of a model can be generated and manipulated in real-time, allowing the creation of custom 'turtle shell' tessellations, large 3D puzzles, organic lamps, and large models with customizable part seams.

• Real-time Global Illumination with Stochastic Lightcuts and Deep Learning Denoising (Wolfgang Tatzgern, Benedikt Mayr)
  While real-time raytracing becomes increasingly mainstream, the compute power of current GPUs is insufficient to establish light paths with multiple bounces, cutting a large fraction of light from scenes and thus making scenes appear 'cold'. We distribute virtual point lights (VPL) for every rendered frame, build a hierarchical data structure on top of the VPLs, and dynamically light the scene from this tree. For scene lighting, we rely on raytracing and stochastic pruning of the light tree. Finally, we use deep learning and temporal filtering to generate smooth and temporally stable images.

• A High-Performance Software Rendering Pipeline for the GPU (Michael Kenzel)
  Interactive graphics, from your desktop to the latest video games, are driven by the awesome speed at which modern graphics hardware can draw little polygons. However, while purpose-built hardware is extremely efficient at doing exactly what it was designed to do, it can also be extremely inefficient at doing anything else. Our mission is to explore the potential of GPU software rendering to take us beyond what current graphics hardware can do.

• Efficient Subdivision Surfaces on the GPU (Daniel Mlakar)
  Subdivision surfaces are an invaluable asset in video games and animation movies. While progress over the last years has allowed the use of graphics hardware to meet performance demands during rendering, existing solutions are limited to immutable mesh connectivity scenarios, as they rely heavily on preprocessed data. Motivated by recent progress in mesh data structures, we show how commonly used subdivision schemes can be abstracted in the language of linear algebra based on the mesh matrix representation and efficiently mapped to specialized GPU kernels. Our approach can provide the artist with a live preview during modeling, eliminating unpleasant idle times.

Vision, Learning & Optimization

• Image Inpainting with Generative Prior (Dominik Narnhofer)

• Sub-pixel Accurate Stereo Reconstruction (Patrick Knöbelreiter)
  See how to use variational optimization and convolutional neural networks jointly to compute precise depth measurements.

• Face to face morphing (Alexander Effland)
  Come and see how your face gets morphed into your friend's face.

Computer Vision for AR

• 3D Room Layout Estimation (Sinisa Stekovic)
  We demonstrate how to estimate 3D room layout from a single RGB image of a cluttered room. Learn how RGB images get transformed into 3D room layouts in an interactive demo.

• Play Super Mario without a Joystick (Mahdi Rad)
  Most games still rely on a joystick as main interaction element. In this demo, we demonstrate that 3D Hand Pose Estimation can be used instead, in particular, for playing a well-known game!