VIRTUAL REALITY & AUGMENTED REALITY
Spring - 2018

Project Proposals

Presenter: ***Anum Masood***

Teaching Assistant

9th March, 2018

Project Proposal

Details

- Project Members: maximum three students in a group
- Email your project proposal and the research paper you selected on

  vr_spring2017@yahoo.com
  - Project proposal should be in pdf format or MS word file.
  - *[file name format: project proposal_ studentID1_studentID2]*
- *DEADLINE for proposal*: 30th March, 2018
- Final Presentation: 1st and 5th June, 2018 (Time: 8am to 9:40 am)
- Deliverables for the final submission:
  - Implementation Code
  - Dataset
  - Final Project Report
  - Project Presentation Slides
  - Demo Video

Course Evaluation

Details

- Assignment = 15
  - Assignment for Course

- Final Project
  - Project Proposal (30th March 2018) + Proposal Presentation (18th and 20th April, 2018 - Time: 8am to 9:40 am) = 10+10 =20 marks

  - Final Project Presentation + Demo Video = 10+5 = 15 marks (15th Week : 1st and 5th June 2018 - Time: 8am to 9:40 am)

  - Project Monthly-Evaluation Meeting = 5+5+5 = 15 marks

    28th March (Topic – Proposal Report + Limitation + Proposed Solution)
    25th April (Implementation + Results)
    23rd May (Presentation + Report Feedback)

    Time + Venue TBD

  - Project Final Report (6th June) = 15 marks

  - Project Implementation (code) 6th June = 20 marks
    - *Code (program files) – 15 marks*
    - *Dataset – 5 marks*

Doing the RIGHT Research

"It is really important to do the right research as well as to do the research right. You need to do **'wow'** research, not just interesting.“

***George Springer**, Chairman of the Aeronautics and Astronautics Department , Stanford University*

How to do it?

Proposal

Structure of Project Proposal

(1) Define your research question

(2) Identify key concepts from your selected research paper

(2) Identify the limitations

(3) Proposed new method to overcome the limitations

Refine your search – broaden or narrow your proposed method

- *Do your proposed method overcomes the limitation?*

Efficient VR and AR Navigation through Multiperspective Occlusion Management [1]

- Immersive navigation in virtual reality (VR) and augmented reality (AR) leverages physical locomotion through pose tracking of the head-mounted display.
- While this navigation modality is intuitive, regions of interest in the scene may suffer from occlusion and require significant viewpoint translation. Moreover, limited physical space and user mobility need to be taken into consideration.
- Some regions of interest may require viewpoints that are physically unreachable without less intuitive methods such as walking in-place or redirected walking.
- Novel approach for increasing navigation efficiency in VR and AR using multiperspective visualization

Holographic Near-Eye Displays for Virtual and Augmented Reality [2]

- How digital holography can be used to build novel near-eye displays for virtual and mixed (or augmented) reality.
- Experiment with true, phase-only holograms in which the image is formed by the interference of laser light.
- Address some of the known limitations of digital holograms and demonstrate how holography can add powerful, new features to near-eye displays: per-pixel focus control, vision correction, and unpresented combinations of form factor and field of view.

Accommodation and Comfort in Head-Mounted Displays [3]

- Head-mounted displays (HMDs) often cause discomfort and even nausea. Improving comfort is therefore one of the most significant challenges for the design of such systems.

- Evaluated the effect of different HMD display configurations on discomfort. We do this by designing a device to measure human visual behavior and evaluate viewer comfort. In particular, they focused on one known source of discomfort: the vergence-accommodation (VA) conflict.

- The VA conflict is the difference between accommodative and vergence response. In HMDs the eyes accommodate to a fixed screen distance while they converge to the simulated distance of the object of interest, requiring the viewer to undo the neural coupling between the two responses.

ACCOMMODATION-INVARIANT NEAR-EYE DISPLAYS [4]

- Although emerging virtual and augmented reality (VR/AR) systems can produce highly immersive experiences, they can also cause visual discomfort, eyestrain, and nausea.
- One of the sources of these symptoms is a mismatch between vergence and focus cues.
- In current VR/AR near-eye displays, a stereoscopic image pair drives the vergence state of the human visual system to arbitrary distances, but the accommodation, or focus, state of the eyes is optically driven towards a fixed distance.
- In this work, they introduce a new display technology, dubbed accommodation-invariant (AI) near-eye displays, to improve the consistency of depth cues in near-eye displays.
- Rather than producing correct focus cues, AI displays are optically engineered to produce visual stimuli that are invariant to the accommodation state of the eye.

Botanical Materials Based on Biomechanics [5]

- Botanical simulation plays an important role in many fields including visual effects, games and virtual reality.
- Previous plant simulation research has focused on computing physically based motion, under the assumption that the material properties are known.
- It is too tedious and impractical to manually set the spatially-varying material properties of complex trees. In this paper, they gave a method to set the mass density, stiffness and damping properties of individual tree components (branches and leaves) using a small number of intuitive parameters.
- Their method is rooted in plant biomechanics literature and builds upon power laws observed in real botanical systems.
- They demonstrated their materials by simulating them using offline and model-reduced FEM simulators.

Implicit Crowds: Optimization Integrator for Robust Crowd Simulation [6]

- Large multi-agent systems such as crowds involve inter-agent interactions that are typically anticipatory in nature, depending strongly on both the positions and the velocities of agents.
- Showed how the nonlinear, anticipatory forces seen in multi-agent systems can be made compatible with recent work on energy-based formulations in physics-based animation, and propose a simple and effective optimization-based integration scheme for implicit integration of such systems.
- They apply this approach to crowd simulation by using a state-of-the-art model derived from a recent analysis of human crowd data, and adapting it to our framework.
- Their approach provides, for the first time, guaranteed collision-free motion while simultaneously maintaining high-quality collective behavior in a way that is insensitive to simulation parameters such as time step size and crowd density. These benefits are demonstrated through simulation results on various challenging scenarios and validation against real-world crowd data.

Computational Imaging With Multi-Camera Time-of-Flight Systems

- Applications, include robotic and machine vision, human-computer interaction, autonomous vehicles as well as augmented and virtual reality.
- Research Paper is based on Design and applications of phased multi-camera time-of-flight (ToF) systems **[7]**.
- Developed a reproducible hardware system that allows for the exposure times and waveforms of up to three cameras to be synchronized.
- Analyzed waveform interference between multiple light sources in ToF applications
- Based on Orthogonal frequency design
- Results: instantaneous radial velocity capture via Doppler time-of-flight imaging and they explored new directions for optically probing global illumination

Erosion Thickness on Medial Axes of 3D Shapes

- In shape understanding, the medial axis is known to be sensitive to small boundary perturbations **[8]**.
- Majority of significance measures over the medial axes of 3D shapes are locally defined (unable to capture the scale of features).
- Introduced global significance measure that generalizes in 3D the classical Erosion Thickness (ET) measure over the medial axes of 2D shapes.
- Precise definition of ET in 3D presented, analyzed its properties, and presented an efficient approximation algorithm with bounded error on a piecewise linear medial axis.
- ET outperforms local measures in differentiating small boundary noise from prominent shape features, and it is significantly faster to compute than existing global measures.

Deep Residual Learning for Image Recognition

- Deeper neural networks are more difficult to train.
- Residual learning framework used to ease the training of networks that are substantially deeper than those used previously.
- Reformulate the layers as learning residual functions with reference to the layer inputs, instead of learning unreferenced functions **[9].**
- Provided comprehensive empirical evidence showing that these residual networks are easier to optimize, and can gain accuracy from considerably increased depth.
- On the ImageNet dataset, evaluated residual nets with a depth of up to 152 layers---8x deeper than VGG nets but still having lower complexity.
- An ensemble of these residual nets achieves 3.57% error on the ImageNet test set.
- This result won the 1st place on the ILSVRC 2015 classification task.

Real-time Skeletal Skinning with Optimized Centers of Rotation

- Skinning algorithms that work across a broad range of character designs and poses are crucial to creating compelling animations.
- Currently, linear blend skinning (LBS) and dual quaternion skinning (DQS) are the most widely used, especially for real-time applications **[11].**
- Both techniques are efficient to compute and are effective for many purposes.
- Due to the popularity of LBS and DQS, it would be of great benefit to reduce these artifacts without changing the animation pipeline or increasing the computational cost significantly. In this paper, new direct skinning method is introduced that addresses this problem.
- Our key idea is to pre-compute the optimized center of rotation for each vertex from the rest pose and skinning weights.
- These centers of rotation are used to interpolate the rigid transformation for each vertex.

Live Intrinsic Video

- Intrinsic video decomposition refers to the fundamentally ambiguous task of separating a video stream into its constituent layers

- Such a decomposition is the basis for a variety of video manipulation applications, such as realistic recoloring or retexturing of objects.

- A novel variational approach is presented to tackle this underconstrained inverse problem at real-time frame rates, which enables on-line processing of live video footage **[12].**

- The problem of finding the intrinsic decomposition is formulated as a mixed variational optimization problem based on an objective function that is specifically tailored for fast optimization.

- To this end, a novel combination of sophisticated local spatial and global spatio-temporal is proposed priors resulting in temporally coherent decompositions at real-time frame rates without the need for explicit correspondence search.

- Compelling real-time augmented reality applications, such as recoloring, material editing and retexturing, are demonstrated in a live setup.


thank you
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THANK YOU ALL FOR LISTENING AND GOOD LUCK FOR YOUR PROJECT