Revision Report

Feedback comment: (Review 1) I would include simulators, a very important application of CG and VR for training, education, planning

How incorporated: added

Why not incorporated:

Date considered: 7/27/2022

Feedback comment: (Review 1) I would include VR/AR or XR, as these areas are becoming more used, as stated below “immersive applications that in 2013 had to run on desktops, can now run on mobile devices”

How incorporated: added AR/VR

Why not incorporated:

Date considered: 7/27/2022

Feedback comment: (Review 1) Maybe more complete: perception and cognition

How incorporated: revised “human perception” to “human perception and cognition”

Why not incorporated:

Date considered: 7/27/2022

Feedback comment: (Review 1) These are H/W oriented color models, not adequate for human specification/selection; I would include a mention to models based on perceptual concepts: such as HLS, or HSV

How incorporated: Changed “Additive and subtractive color models (CMYK and RGB) and why these provide a range of colors” to “Additive and subtractive color models (CMYK and RGB) and a color perception based model (HSV)”

Why not incorporated:

Date considered: 07/27/2022

Feedback comment: (Review 1) I would maintain only visual representations of data; what is information is a complex topic. Information Visualization starts also with data.

How incorporated: “Visualization is the process of creating graphical representations of information and data.” to “Visualization is the process of creating graphical representations of data.”

Why not incorporated:

Date considered: 07/27/2022

Feedback comment: (Review 1) Add bullet Scientific Visualization and Information Visualization to Visualization Section.

How incorporated: Added

Why not incorporated:

Date considered: 07/27/2022

Feedback comment: (Review 1) color mapping, isosurfaces and parallel coordinates are techniques; I suggest removing them from this list of otherwise types of data or add a list of common techniques in each case

How incorporated: removed

Why not incorporated:

Date considered: 7/27/2022

Feedback comment: (Review 1) Add mention of AR/MR and VR and their differences.

How incorporated: Added "Define and distinguish VR, AR, and MR"

Why not incorporated:

Date considered: 01/24/2023

Feedback comment: (Review 1) I would add Evaluation as a crosscutting bullet

How incorporated: added

Why not incorporated:

Date considered: 07/27/2022

Feedback comment: (Reviewer 1) Add Immersive interfaces / 3D user interfaces and Physical Interfaces

How incorporated: Added the following

- Immersive Interfaces (AI crosscutting)
    - brainwave (EEG type electrodes)
    - headsets with embedded eye tracking
    - AR glasses

Why not incorporated: I think of hardware connections when I think of the term " physical interfaces". I believe the existing bullet point labeled "haptics" should suffice...

Date considered: 07/28/2022

Feedback comment: (Reviewer 1) A potentially important illustrative outcome would be identifying the most important technical characteristics of a VR system/application that need to be controlled to avoid motion sickness.

How incorporated: added to the illustrative outcome for Immersion… " Identify the most important technical characteristics of a VR system/application that should be controlled to avoid motion sickness and explain why."

Why not incorporated:

Date considered: 07/28/2022

Feedback comment: Implement basic algorithms for scalar and vector visualization.

Comment: These are typical of scientific visualization; algorithms to implement basic visualization techniques for abstract data should be considered (e.g. for graph visualization); or keep this general

How incorporated: Removed " Implement basic algorithms for scalar and vector visualization." It is better

Why not incorporated:

Date considered: 7/28/2022

Feedback comment: No discussion of how image manipulation and light-reflection-based technologies can harm dark-skinned people.

How incorporated: Added an SEP section

- SEP issues
    - Deep fakes
    - Applications that misidentify people with dark skin
- Learning outcome
    - Describe the ethical pitfalls of facial recognition. Can facial recognition be used ethically? If so, how?

Why not incorporated:

Date considered: 10-12-2022

Feedback comment: Professionalism standards are often racist, classist, and ableist. Some examples from GIT that are problematic:

- "self-starter, independent"
- "Self-directed: self-learner, self-motivated"
- "Flexible"
- "Meticulous: attentive to detail, thorough"
- "Oral" communication

How incorporated: Polling the group? TBD

Why not incorporated:

Date considered: 10/12/2022

Feedback comment: change "....manipulation of images. It is the science of enabling visual" to "manipulation of images, and can be viewed as the science of enabling visual" (reviewer 2)

How incorporated: done

Why not incorporated:

Date considered: 10/12/2022

Feedback comment: I'm not sure who the audience is, but having a semicolon-delimited list early on can be off-putting. (reviewer 2)

How incorporated:

Why not incorporated: the audience is academics and the semi-colons serve to delimit a list of items which contain commas, so it should be ok. Right?

Date considered: 10/12/2022

Feedback comment: "examples of API's, programs, and languages should be considered as appropriate examples in 2022. In effect, they are a snapshot in time.." should become "examples of APIs, programs, and languages should be considered as appropriate examples in 2022. In effect, they are a snapshot in time.."

How incorporated: done

Why not incorporated:

Date considered: 10/12/2022

Feedback comment: Transition here(from 1st paragraph to 2nd) is awkward. Are we still talking about advanced graphics, or have we moved on to a new topic?

How incorporated: modified 2nd paragraph from

With a balance of theory and applied instruction, computer science students who learn content from the knowledge units specific below will be able to understand, evaluate, and/or implement the related graphics and interactive techniques as users and developers.

to

Undergraduate computer science students who learn content from the knowledge units specified below through a balance of theory and applied instruction, will be able to understand, evaluate, and/or implement the related graphics and interactive techniques as users and developers.

Why not incorporated:

Date considered: 10-12-2022

Feedback comment: Change "Animations, games, visualizations, and immersive applications that in 2013 had to run on desktops in 2013, can now run on mobile devices. The amount of data grew exponentially since 2013, and both data and visualizations are now published by myriad sources including news media as well as scientific organizations" to "Animations, games, visualizations, and immersive applications that ran on desktops in 2013, can now run on mobile devices. The amount of data grew exponentially since 2013, and both data and visualizations are now published by myriad sources including news media and scientific organizations

How incorporated: changed verbatim

Why not incorporated:

Date considered: 10-12-2022

Feedback comment: Change "For nearly every computer scientist and software developer, an understanding" to "For nearly every computer scientist and software developer, understanding"

How incorporated: changed verbatim

Why not incorporated:

Date considered: 10-12-2022

Feedback comment: I'm not sure aliasing counts as contrast detection.

How incorporated: It wasn't meant to be an example of contrast detection, but the result of a poorly placed paren

changed

- contrast detection (Mach banding/dithering/aliasing)

to

- contrast (detection/Mach banding/dithering/aliasing)

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: sampling and quantization (HCI Foundations), reviewer 2 questioned what this was

How incorporated: it was our reminder to cross reference HCI, clarified with

sampling and quantization (Cross-reference HCI Foundations)

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: remove 1) space from “color image”, 2) space after file format, & 3) empty paragraph break in cs core

How incorporated: corrected

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: the forward and backward rendering equation

How incorporated: change to ”the rendering equation” which is less confusing than the more inclusive “forward and backward rendering equation”

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: I’ve always found it really confusing that the scanline/raster algorithm is referred to as “the graphics pipeline”. This implies that ray tracing fits into it, when in fact it is a different algorithm. Students always get confused. Also, it implies that everything in graphics fits in this pipeline, including modeling and simulation, which is clearly not true.

I would prefer “Describe the scanline pipeline”.

How incorporated: Changed “graphics pipeline” to “rendering pipeline”.

Why not incorporated: rendering pipeline is what is more commonly used than scanline pipeline.

Date considered: 10-13-2022

Feedback comment: “Bezier curves, spline curves and surfaces, and non-uniform rational basis spines (NURBS , and level set method.” should become

- Bezier curves, spline curves and surfaces, and non-uniform rational basis spines (NURBS), subdivision surfaces, and level set methods.

How incorporated: correction applied

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: Re REYES micropolygon**….** It’s really a stretch to call this an approximation of the rendering equation.

Also, why the sudden transition to “REYES / micropolygon” terminology? The terms “graphics pipeline” and “rasterization” have already been deployed to describe this approach. The switch in terminology is confusing.

How incorporated: removed “REYES micropolygon”

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: re blend shapes, This seems pretty deep-cut for an undergraduate class. Would they ever implement such a thing themselves?

How incorporated:

Why not incorporated: They may not implement it but in Maya or other 3D animation package, may use it so should understand it.

Date considered: 10-13-2022

Feedback comment: *"is some mesh of"* with *"to achieve a mixture of"*

How incorporated: changed *"is some mesh of"* to *"to achieve a mixture of"*

Why not incorporated:

Date considered: 10-13-2022

Feedback comment: for Simulations Revise: *with corrections and additions*

How incorporated: all accepted

Why not incorporated:

Date considered: 1-09-2023

Feedback comment: for math, suggested additions and clarifications

How incorporated: all accepted

Why not incorporated:

Date considered: 1-09-2023

Feedback comment: (Review 3) A note about intersection with machine learning, data science and computer vision would be modern and more motivating.

How incorporated: Edited text below to add data science and computer vision

Graphics as a knowledge area has expanded and become pervasive since the CS2013 report. Machine learning, computer vision, data science, AI, and the inclusion of embedded sensors in everything from cars to coffee makers utilize graphics and interactive techniques.

Date considered: 01/23/2023

Feedback comment: (Review 1) I am not an expert in simulation, but "the goal instead is some mesh of physical plausibility and artistic intention." seems a rather strange statement; e.g. in a simulation to support surgery planning or training is it adequate to have an artistic intention?

I believe this may be interesting in some instances, not always…

How incorporated: Language cleaned up "mesh" -> "mixture of"

Why not incorporated:

Simulation is cross-cutting, so the intent of this is to somewhat isolate what sort of simulations belongs more under the graphics umbrella. Purely predictive simulation may be addressed in other HCIs, but where the end point is graphic output there arise different approaches that are worth teaching explicitly.

Date considered: 01/09/2023

Feedback comment: (Review 3) The application examples should be broadened to include things that are becoming prevalent in society and will pose important ethical questions for future students, such as self-driving cars, deep-space imaging, computational photography, deep fakes in media, and facial recognition.

How incorporated: Added

It is critical that students learn about the ethical questions and conundrums that have arisen and will continue to arise because of applications in computer graphics—especially those paired with machine learning, data science, and artificial intelligence. Prevalent in today's media are examples of inequity and wrong-doing related to autonomous navigation, deep-space imaging, computational photography, deep fakes, and facial recognition.

Date considered: 01/23/2023