Mark Grundland

Style and Content in Digital Imaging

Reconciling Aesthetics with Efficiency in Image Representation

6.4 Outlook

The directions of my research reflect my personal outlook on the future possibilities of visual media. The story of digital art is just beginning. In the last fifty years, only the first chapters have been drafted and they are still open to revision. I feel fortunate to be living in the great age of exploration for digital art, when one can still sense the presence of vast uncharted territories just off the outer edges of the map. Whenever science and art embark together on a voyage of discovery, they transform popular culture along the way, as seen in the last century's history of photography and cinema. What will the next century bring now that everyone has a camera?

In the future, style design, the development of reusable visual transformations, may be as commonplace as graphic design, the creation of reproducible visual representations. Visual styling is fast becoming a vital component of image and video production, just as graphic design has become an essential element of online and print publishing. Already, in cinematography, the design of the visual look and feel of a film is crucial in conveying the emotional subtext of its narrative. Likewise, in advertising, international brands are made instantly recognizable by the unique style they project. Just as live action and computer animation have been shown to mix seamlessly, the conventional distinctions between photorealistic reproduction and non-photorealistic rendition are now receding in the eyes of artists and audiences, if not yet in the minds of computer graphics researchers. Hence, digital style design may one day soon be recognized as a legitimate new form of visual art. To make this future possible, significant technical advances are required in the ways pictures are stored, analyzed, and synthesized. Image and video representations need to efficiently and effectively separate the specification of style from the description of content. For instance, the use of a style track in video production may enable the director to control how color, grain, and focus change over time.

Furthermore, image and video models require a more sophisticated appreciation of the visual form and its significance, moving beyond the mere surface recognition of line, contrast, color, texture, and shape to a much deeper understanding of object, structure, composition, semantics, and connotation. For instance, the internet's vast image and video repositories, which are searchable, annotated, and rated, may be harnessed by unsupervised learning algorithms to recognize the characteristic patterns correlated with meaningful interpretations, such as mood and genre. Whereas most image transformation techniques still operate on pixel arrays, recent advances in image analysis, segmentation, and understanding may enable future algorithms to transform hierarchies of visual elements and contextual information captured at multiple scales and viewpoints. It is already a significant challenge to integrate 2D appearance with 3D geometry and 4D motion. It is a greater challenge still to apply such information effectively to develop the complex visual operators, such as simplification and abstraction or exaggeration and emphasis, which have the expressive capacity to influence the viewer's impression of the picture. Image and video stylization requires design tools that have the flexibility to accommodate authentic artistic expression. Although there are many available user interfaces for style specification, including parameter tuning, multiobjective optimization, rendering by example, interactive evolution, design galleries, visual programming and scripting languages, none as yet offers the expressive freedom, the visual impact, and the ease of use that their creative task truly demands. A possible avenue for future research is to investigate how these very diverse approaches could be best integrated and unified within a single style design system.

Finally, computation may make possible new modes of visual expression. Already, computer graphics has given rise to new art forms, including fractals, photomosaics, and image metamorphosis. Yet, there remain possibilities left largely unexplored. For instance, compositing is the key stage of image and video production where the elements of the picture come together. In digital art, as never before, images constitute both the input and output of the picture making process. Increasingly, composite imagery is being composed of ever more component images interacting in ever more complex ways. Sampling and remixing could become standard practice in certain styles of depiction as it is today in certain types of music, possibly prompting a reconsideration of visual copyright. In digital paint systems, images may augment colors and textures as fundamental painting primitives. The

image-based brush strokes of a visual composition could be drawn from the limitless palette of the internet. For instance, such compositions could literally express multiple levels of meaning by resembling their mediated subject at a glance and their immediate components upon closer examination. New figurative and abstract forms of painting and animation may yet emerge from thousands of images arranged in concert, deeply layered with subtle transparency, rivaling the organic complexity found in nature.

Of course, these musings may turn out to be merely amusing speculations. If the future of visual art could be imagined, it would be here today – technology permitting. How can image processing express the imagination? Now, it is your turn to let me know[3].

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Graphic design draws a fundamental distinction between style and content, as in font and text. Applying the same principle to digital photography, this work proposes a novel image representation that separates the specification of rendering style from the description of informative content, enabling style and content to be saved, changed and reused independently. From the abstract to the figurative, this technique represents images at progressive levels of detail. It also supports interactive style design using genetic programming. As every image has a grain, there is always a resolution where stylized depiction must take the place of exact reproduction. Intentional stylization enables visual artifacts to play a constructive role in visual communication by making abstraction and simplification appear legitimate. Painterly rendering styles that encourage the viewer`s imagination to complete the picture can act as a powerful form of image compression. Based on University of Cambridge research, this book presents students, researchers, and practitioners of image processing and computer graphics with a new perspective on representation, compression, and stylization in digital imaging.

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Mark Grundland is a research and development consultant. Combining computer graphics, computer vision and visual art, his research investigates how image processing tools can be designed to express the imagination and expand the creative possibilities of digital media. He received a PhD in image processing from the University of Cambridge in 2007.

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