

# Preface

“Computers are useless. They can only give you answers.”  
Pablo Picasso, 1881–1973.

Almost two hundred years ago, the advent of photography was heralded as the beginning of the end for traditional painting. Rather than rendering painting obsolete, the technology instead motivated a new era of abstraction in visual art, delivering—among many other movements—Impressionism, Futurism, and Cubism, which continue to inspire contemporary art. Similarly, the astonishing achievements in visual realism delivered by Computer Graphics have motivated new research into the rendering of non-photorealistic styles. Non-photorealistic Rendering (NPR) is now a firmly established field within Computer Graphics, spanning over two decades of research. With origins in artistic simulation and scientific visualization, NPR has now broadened to intersect computational photography, perceptual modelling and interaction design. NPR research regularly appears in top tier graphics conferences and journals, and has delivered commercial impact through digital photography and mobile applications, and through the creative industries.

This book assembles a catalogue of classical and contemporary techniques capable of transforming 2D footage—i.e. images and video—into synthetic artwork. This sub-discipline within NPR is often referred to in the literature as *Artistic Rendering*, and sometimes by the more specific title *Artistic Stylization*. Even limiting ourselves to the rendering of images and video primarily for aesthetic value, there has been a huge diversification and development of the field over the past decade—approximately the time since the last survey of the field was published.

One significant development has been the emergence of NPR as a truly multi-disciplinary field; a focal point for the convergence of Computer Graphics, Computer Vision, Human Computer Interaction and perceptual Psychology. The convergence with Computer Vision is particularly relevant to this book’s topic of 2D artistic stylization. The increasing complexity and diversity in style demanded by techniques demands a correspondingly greater degree of sophistication in the parsing and extraction of information from source footage. In the mid-1990s when automated artistic stylization techniques began to emerge, there was a reliance upon

low-level image processing operators to guide the rendering process. In the early 2000s mid-level interpretation of imagery through image segmentation, perceptual salience measures, and more sophisticated filtering operators yielded improved style diversity and the robustness and temporal stability necessary to coherently stylize video. As the field matures it is now common to see a fusion of even more sophisticated image parsing, combined with careful interface design, recognizing the role of artistic stylization as a practical creative tool. Consequently in recent years, this research has begun to deliver commercial impact in major digital image and video manipulation products.

The structure of this book echoes this categorization of artistic stylization research. Part I focuses upon image stylization through the placement of marks (such as strokes, hatches and stipples), or through non-linear filtering operators. This is arguably the largest area of 2D stylization research, and also one of the most active. Part II focuses on region-based techniques that require images to be parsed into a visual structure via interactive or automated algorithms. Regions may be shaded using a variety of gradient effects, or packed with rendering primitives such as strokes, space filling curves, tiles and other marks. Furthermore, scene semantics may be derived from regions enabling specialised rendering to be applied e.g. to enable portrait rendering. Part III extends the discussion of both categories of stylization to video, and explores both low-level methods based on optical flow, and mid-level methods based on regions. In addition to processing real video into stylized animation, the issue of processing existing animations into other stylized forms is discussed. Finally, Part IV discusses the matter of evaluating NPR output. As the field of artistic stylization matures, key questions include how to assess the benefits of a new proposed approach, and how to assess the suitability of a particular approach to a particular requirement or scenario. In this book we present complementary perspectives on the matter of evaluating a rendering generated primarily for aesthetics. Finally, we discuss the emerging commercial impact of NPR “in the wild”; that is, the application of NPR to real world scenarios. Crucially this requires consideration of the users of NPR and its creative implications.

Picasso doubted the benefit of computers on the basis that they are merely powerful calculating machines. Yet research in our field has shown that, enabled by such machines, we can begin to ask new questions about art, computing, and their interaction. With advances in Vision, Machine Learning, and Human Factors merging into this maturing sub-discipline with Computer Graphics, this is an exciting time to be working in NPR.

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