

The Impact of Artificial Intelligence on The Animation and VFX Industry

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Abstract—Artificial Intelligence (AI) is rapidly transforming the animation and visual effects (VFX) industry, redefining workflows, creative processes, and production timelines. This paper examines the multifaceted impact of AI technologies including machine learning, deep learning, generative models, and neural rendering on key areas such as AI-generated animation, compositing pipelines, rotoscoping, motion capture, and visual effects generation. Drawing on secondary research and industry reports, this study explores the tools and platforms deployed by industry-leading companies including Adobe, Autodesk, SideFX (Houdini), Runway ML, NVIDIA, and others alongside both the opportunities and challenges that AI presents for professionals and students in the field. The findings suggest that while AI significantly enhances efficiency and opens new creative avenues, it also raises pressing concerns regarding skill displacement, authorship, and the ethical use of generative tools.

Index Terms—Artificial Intelligence, Animation, VFX, Machine Learning, Generative AI, Neural Rendering, Motion Capture, Adobe After Effects, Houdini, Compositing

I. INTRODUCTION

The animation and VFX industry have undergone a paradigm shift over the last decade, driven significantly by advancements in Artificial Intelligence. Traditionally, animation required painstaking manual effort from hand-drawn frames to keyframe-based 3D animation demanding both technical skill and considerable time. Visual effects, similarly, involved highly labour-intensive compositing and simulation pipelines. Today, AI-powered tools are automating many of these processes, enabling studios of all sizes to produce high-quality content faster and more cost-effectively. The global animation market was valued at approximately USD 411 billion in 2023 and is

projected to grow steadily, with AI integration being a key driver of this growth (Grand View Research, 2024). From real-time rendering to AI-assisted compositing in Adobe After Effects and procedural simulation in SideFX Houdini, the scope of AI's influence is vast and accelerating. This paper investigates how AI is reshaping the discipline, which specific tools and techniques are being adopted by leading studios and technology companies, and what the implications are for industry professionals and students entering the field.

Four core areas are examined in depth: AI-generated animation, AI tools in compositing, automation in VFX pipelines, and the ethical concerns surrounding these technologies. By situating current tools within a broader analytical framework, this paper aims to provide a comprehensive understanding of where the industry stands and where it is heading.

II. LITERATURE REVIEW

Several scholars and industry analysts have studied the intersection of AI and animation. Mikros Image and Weta Digital have been documented as early adopters of machine-learning pipelines for crowd simulation and de-aging effects (Robertson, 2022). Research by Karras et al. (2019) on Generative Adversarial Networks (GANs) demonstrated that AI could generate photorealistic human faces, a breakthrough with direct implications for character design in animation and VFX.

Studies on AI-assisted rotoscoping tools, such as Adobe's Roto Brush 2.0 powered by the Sensei AI engine, indicate significant reductions in post-production time tasks that once took hours can now be completed in minutes (Adobe Inc., 2021). Similarly, motion capture has been revolutionised by pose

estimation frameworks like OpenPose and MediaPipe, allowing markerless capture using standard cameras rather than expensive marker-based suits.

In the domain of procedural VFX, SideFX Houdini has emerged as the industry standard, and its integration with machine learning libraries has opened pathways for AI-guided simulation. Autodesk's suite of tools including Maya and Flame has progressively incorporated AI-driven features for rigging assistance, predictive rendering, and automated retiming.

Scholars such as Brundage et al. (2018) have raised concerns about the ethical dimensions of AI-generated media, including deepfakes and creative ownership issues increasingly relevant to the VFX profession. The literature broadly acknowledges that AI does not eliminate the need for skilled artists; rather, it shifts the nature of skills required from repetitive technical execution toward higher-order creative direction and supervision of AI-driven workflows (Huang & Rust, 2021).

III. RESEARCH METHODOLOGY

This research adopts a qualitative, secondary research methodology. Data was gathered from peer-reviewed journals, industry white papers, published case studies, and credible online sources including reports from SIGGRAPH, the Visual Effects Society (VES), and technology companies such as NVIDIA, Adobe, Autodesk, and SideFX. The study employs a thematic analysis approach, identifying recurring themes relating to AI applications, benefits, challenges, and future directions in animation and VFX. No primary data collection was conducted; instead, existing knowledge and documented industry experiences were synthesised to draw meaningful conclusions. The thematic categories chosen AI-generated animation, compositing tools, pipeline automation, and ethics reflect the most prominently recurring domains in current industry literature.

IV. DATA ANALYSIS AND FINDINGS

4.1 AI-Generated Animation

AI-generated animation represents one of the most significant recent disruptions to the industry. Traditional 2D and 3D animation relied on artists manually crafting every frame or keyframe, a process inherently time-consuming and costly. AI has altered this reality across multiple sub-disciplines.

4.1.1 In-Betweening and Keyframe Generation

In-betweening the process of creating intermediate frames between two keyframes was among the first tasks to be automated. Tools such as Reallusion's AccuLips and various deep-learning interpolation models can now generate smooth motion curves between defined poses, dramatically reducing the workload on animators. According to the VES Technology Report (2023), studios report up to 60% reductions in time spent on in-betweening and cleanup work when AI tools are deployed.

4.1.2 Character Rigging and Performance Transfer

Autodesk has integrated AI-assisted rigging features into Maya, the industry-standard 3D animation package. Machine learning models trained on large datasets of character rigs can predict and auto-generate bone structures for new characters, reducing setup time from days to hours. Additionally, performance transfer systems powered by deep learning can map facial performances captured via video onto 3D characters with high fidelity, as seen in tools integrated into Autodesk MotionBuilder.

4.1.3 Generative AI for Concept and Style

Generative AI models including Stable Diffusion, Midjourney, and DALL-E are now used extensively in pre-production for concept art, character ideation, storyboarding, and texture generation. While these tools dramatically accelerate the ideation phase, they have sparked significant debate around intellectual property, artist credit, and the value of original artistry. Studios such as Netflix Animation and major game developers have publicly addressed their internal policies around generative AI use, reflecting the industry-wide reckoning with these tools.

4.2 AI Tools in Compositing

Compositing the process of layering multiple visual elements into a coherent final image has historically been one of the most labour-intensive stages of VFX production. AI has transformed several key compositing tasks, particularly within tools like Adobe After Effects and Autodesk Flame.

4.2.1 Adobe After Effects and Sensei AI

Adobe's After Effects, the industry-standard compositing and motion graphics application, has been progressively enhanced with AI capabilities through Adobe Sensei, the company's AI and machine

learning framework. The most notable advancement is Roto Brush 2.0, released in 2021, which leverages AI to perform subject masking and rotoscoping in a fraction of the time previously required. The tool uses a neural network trained on millions of image pairs to intelligently track subject boundaries across frames even through motion blur, hair, and fine detail. Adobe has continued expanding its AI toolkit with Content-Aware Fill for video, which uses AI to remove unwanted elements from footage and intelligently reconstruct the background.

In 2023 and 2024, Adobe introduced Generative Extend in After Effects (powered by Adobe Firefly), enabling users to extend footage seamlessly using AI generation a tool particularly valuable for compositors working with limited source material. These additions represent a fundamental shift in how compositing artists interact with the software, moving from manual, pixel-level operations to directing AI systems.

4.2.2 Autodesk Flame and AI-Driven Colour Matching

Autodesk Flame, widely used in high-end broadcast and film finishing, has incorporated AI-driven tools for automated colour matching between shots, intelligent stabilisation, and machine-learning-based noise reduction. These features reduce the burden on colourists and compositors during the conforming and online editing stages, allowing greater focus on creative decisions.

4.2.3 Runway ML

Runway ML has emerged as a leading AI-first video editing and compositing platform, offering tools for generative video creation, background removal, motion tracking, and AI-driven inpainting all within a browser-based interface accessible to smaller studios and independent creators. Runway's Gen-2 and Gen-3 models enable text-to-video and image-to-video generation at quality levels that increasingly rival traditional VFX for certain applications.

4.3 Automation in VFX Pipelines

Beyond individual tools, AI is reshaping entire VFX production pipelines the structured sequence of processes from pre-production through final delivery. Automation is penetrating multiple stages of this pipeline, with implications for staffing, budgeting, and creative control.

4.3.1 SideFX Houdini and Procedural AI Simulation

SideFX Houdini is the leading procedural 3D software for VFX, used extensively for simulating fire, water, destruction, crowds, and other complex phenomena. Houdini's node-based, procedural architecture is inherently compatible with AI and machine learning integration. Studios have developed ML models trained on large simulation datasets that can approximate and, in some cases, replace traditional physics solvers for certain types of simulations, dramatically reducing computation time.

Houdini's Machine Learning (ML) Solver and its integration with PyTorch allow technical directors to train neural networks directly within the Houdini environment. For example, fluid simulation caches that previously required hours of computation can be predicted in near real-time using trained ML models, enabling faster iteration during production. Major VFX houses including Industrial Light & Magic (ILM) and MPC have documented the use of ML-enhanced Houdini pipelines for large-scale destruction and environmental effects.

4.3.2 NVIDIA and Real-Time Neural Rendering

NVIDIA has been a central force in advancing AI-driven rendering for VFX. Its NeRF (Neural Radiance Fields) technology enables the creation of photorealistic 3D scenes from a sparse set of 2D photographs, with direct applications in virtual production and set extension. NVIDIA DLSS (Deep Learning Super Sampling), while originally developed for gaming, is now integrated into production rendering pipelines, using AI to upscale lower-resolution renders to final quality reducing render times by up to 50% without significant quality loss.

Real-time ray tracing, enhanced by AI denoising, is now standard in Unreal Engine 5, blurring the boundary between game graphics and cinematic VFX. This convergence has enabled virtual production techniques popularised by productions like *The Mandalorian* where in-camera VFX replace green screen, powered by real-time Unreal Engine environments.

4.3.3 Automated Asset Management and Quality Control

AI is also being applied to asset management and quality control tasks within large VFX pipelines. Machine learning models can automatically flag

continuity errors, rendering artifacts, or inconsistencies in colour between shots tasks previously assigned to dedicated quality control artists. Companies including DNEG and Framestore have invested in proprietary ML-based QC tools that scan rendered frames against reference imagery to identify defects before final delivery.

4.4 Ethical Concerns

The rapid integration of AI into animation and VFX raises a set of ethical challenges that the industry is actively grappling with. These concerns span professional displacement, intellectual property, misuse of technology, and the erosion of creative standards.

4.4.1 Job Displacement and Workforce Restructuring

The risk of job displacement particularly for junior and mid-level artists performing repetitive tasks is among the most pressing concerns. Roles such as roto artists, paint artists, match-move artists, and in-betweeners are most immediately vulnerable to automation. While proponents argue that AI creates new roles and elevates the work of remaining artists, the transition is not seamless, and the pace of automation is outstripping retraining opportunities for many professionals. The Animation Guild and other industry unions have been in active negotiations around the use of AI in productions, reflecting the organised labour community's response to these concerns.

4.4.2 Deepfakes and Unauthorised Likeness Use

The ability of AI to convincingly replicate human faces and voices a capability with obvious utility in de-aging, posthumous performances, and character recreation also carries significant potential for misuse. Deepfake technology, accessible through tools available to the general public, has been used to create non-consensual synthetic media of real individuals,

including performers and public figures. In response, the Screen Actors Guild-American Federation of Television and Radio Artists (SAG-AFTRA) reached a landmark agreement with major studios in 2023 that included explicit provisions on the use of AI-generated likenesses, requiring performer consent and compensation.

4.4.3 Copyright and Authorship of AI-Generated Content

Generative AI models trained on large datasets of existing artwork and imagery raise fundamental questions about copyright and authorship. Multiple lawsuits have been filed by visual artists against companies including Stability AI and Midjourney, alleging that training on copyrighted artwork without consent or compensation constitutes infringement. In the animation and VFX context, the use of generative tools to reproduce an artist's distinctive style without attribution or remuneration is widely viewed as ethically problematic and potentially legally actionable.

Furthermore, the question of who owns AI-generated content the artist who wrote the prompt, the company that built the model, or neither remains legally unresolved in most jurisdictions, creating uncertainty for studios and independent creators alike.

4.4.4 Bias and Cultural Representation

AI models trained predominantly on Western or homogeneous datasets may reproduce and amplify biases in character representation, aesthetic defaults, and cultural assumptions. For an industry responsible for shaping global visual culture, the lack of diversity in AI training data poses risks not only of biased outputs but of further marginalising underrepresented communities and artistic traditions in mainstream media production.

V. KEY AI TOOLS AND COMPANIES

The following table summarises the primary AI tools and companies discussed in this paper, their function, and their application domain within animation and VFX.

Company / Tool	Product	AI Feature	Application Area
Adobe	After Effects	Sensei AI, Roto Brush 2.0, Generative Extend	Compositing, Rotoscoping
Adobe	Premiere Pro / Firefly	AI text-to-video, Content-Aware Fill	Editing, VFX Generation
Autodesk	Maya	AI-assisted rigging, auto-skinning	Character Animation

Autodesk	Flame	AI colour match, stabilisation, noise reduction	Finishing, Compositing
SideFX	Houdini	ML Solver, PyTorch integration	VFX Simulation, Pipeline
NVIDIA	DLSS / NeRF	Neural upscaling, radiance fields	Rendering, Virtual Production
Runway ML	Gen-2 / Gen-3	Text-to-video, inpainting, BG removal	Generative VFX, Compositing
Reallusion	AccuLips / iClone	AI lip-sync, motion interpolation	Character Animation
Epic Games	Unreal Engine 5	Lumen, Nanite, AI denoising	Real-time VFX, Virtual Production
Stability AI / Midjourney	Stable Diffusion / Midjourney	Generative image synthesis	Concept Art, Texture Generation

VI. CONCLUSION AND RECOMMENDATIONS

Artificial Intelligence is undeniably transforming the animation and VFX industry, offering powerful tools that enhance productivity, democratise production, and expand creative possibilities. From AI-generated animation systems that automate in-betweening and character rigging, to compositing tools like Adobe After Effects' AI-powered Roto Brush and generative capabilities, to simulation automation within Houdini and real-time neural rendering via NVIDIA's technologies AI is embedded across the full production pipeline.

However, this transformation is not without its challenges. The industry must navigate issues of authorship, ethical AI use, workforce adaptation, and cultural representation with deliberate care. The pace of AI advancement is outstripping regulatory and institutional frameworks, placing the burden of ethical governance largely on individual studios, industry bodies, and professional unions.

For students and emerging professionals in animation and VFX, building competency in AI-assisted workflows is no longer optional it is essential. Fluency with tools such as Adobe After Effects' AI features, Houdini's ML integration, Autodesk's AI-assisted rigging, and emerging generative platforms will be a baseline expectation in the industry within the next five years.

Educational institutions should update curricula to include modules on AI-assisted workflows, ethical AI use, prompt engineering for creative applications, and critical evaluation of AI-generated outputs. Industry bodies should develop clearer guidelines on the use of generative AI to protect artists' rights while fostering innovation. Studios should invest in transition and retraining programmes for artists whose roles are most immediately impacted by automation.

Ultimately, AI in animation and VFX is best understood not as a replacement for human creativity, but as a powerful new medium for its expression one that requires skilled artists to direct, supervise, and critically evaluate its outputs. The future of the industry will be defined not by those who resist AI, but by those who learn to wield it with both technical mastery and creative wisdom.

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