

Title of Project:

(English)	Developing an Efficient Animation Production Pipeline via Deep Production Material Understanding and Motion Analysis
(Chinese)	基於深度製作素材理解與運動分析之高效動畫製作流程開發

Traditional animation production relies heavily on manual labour, requiring artists to create each frame through a multi-stage process. This begins with rough sketches to define character designs, scene compositions, and camera movements, followed by colorization, cel-shading, and final refinements to produce fully polished animation. This workflow is time-consuming and resource-intensive, often limiting production to large studios with substantial budgets. For example, a single season of a traditionally animated 20-minute TV series can cost around \$1 million, contributing to the high financial barrier in animation production. Existing AI solutions are primarily designed for natural photographs and videos, making them unsuitable for mimicking the animation workflow. This project aims to integrate artificial intelligence into key stages of the animation pipeline, automating critical tasks such as storyboard parsing, animatics generation, keyframe colorization, and motion synthesis, thereby reducing production costs and accelerating creative workflows.

Our first foundational objective of this project is to develop an AI-driven storyboard parsing model that translates rough sketches and their corresponding annotations into structured, machine-readable representations. Storyboards serve as the foundation for both animation and film production, making this advancement beneficial across industries. By understanding storyboards, this model will be able to extract useful scene compositions, object motions, and camera movements, to automate early-stage animation planning, reducing manual effort. Building upon this, we continue to develop an AI-assisted generation process that transforms parsed storyboard data into motion animatic sequences. Since final animation frames are not directly derived from storyboards, animatics act as an intermediary step, previewing motions and defining shot transitions and colorization concepts. Using a sequence-level transformer model, our approach will generate animatic sequences, with key characters, scenes and compositions consistent and visually plausible across long periods of time. Finally, the project will integrate AI into keyframe colorization and motion synthesis to accelerate animation rendering. AI-assisted models will infer shading, lighting, and textures from storyboard descriptions and colour hints, allowing for interactive artistic adjustments. Motion synthesis will generate fluid motion from an input coloured frame, or across coloured frames, with interactive camera and object controls made possible to ensure artistic precision. By automating these traditionally expensive processes, our approach is expected to significantly lower animation production costs while maintaining high visual quality.

Beyond these technical developments, the project also aims to address the scarcity of structured animation datasets by compiling annotated storyboard sketches, animatics, and final rendered animation clips into a large-scale unified dataset for future research. Additionally, the research components will be integrated into an interactive AI-assisted system, allowing artists to take full intuitive control at all production stages, including character movements, scene compositions, colour schemes and other aspects, ensuring that AI-generated content aligns seamlessly with artistic intent. To encourage further research and adoption of AI in animation production, key findings will be published in academic papers and conferences, and datasets, models, and code will be released under an open-source framework for broader accessibility.

Given the global animation industry's estimated \$400 billion valuation in 2024, the potential impact of AI-driven animation tools is substantial. By bridging AI and artistic workflows, this project seeks to enhance production efficiency, reduce costs, and provide animators with advanced tools that streamline the creative process while maintaining artistic expressiveness and control. Furthermore, as storyboard and animatics processing are integral parts of movie production as well, the proposed AI advancements could quickly extend their benefits to the film industry, particularly in pre-production and directing stages.