

グラフィニカにおけるR&D: 3年間の進捗

R&D at Graphinica: 3-Year Progress

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- 2017年に東京大学より博士号取得
Received his Ph.D. in 2017 from the University of Tokyo
- 2017年より産業技術総合研究所（産総研） 研究員
Researcher at AIST since 2017, Senior Researcher since 2022
- 2021年より **株式会社グラフィニカ技術顧問** を兼職
Technical Advisory at Graphinica, Inc. since 2021



グラフィニカとは？ / What is Graphinica?

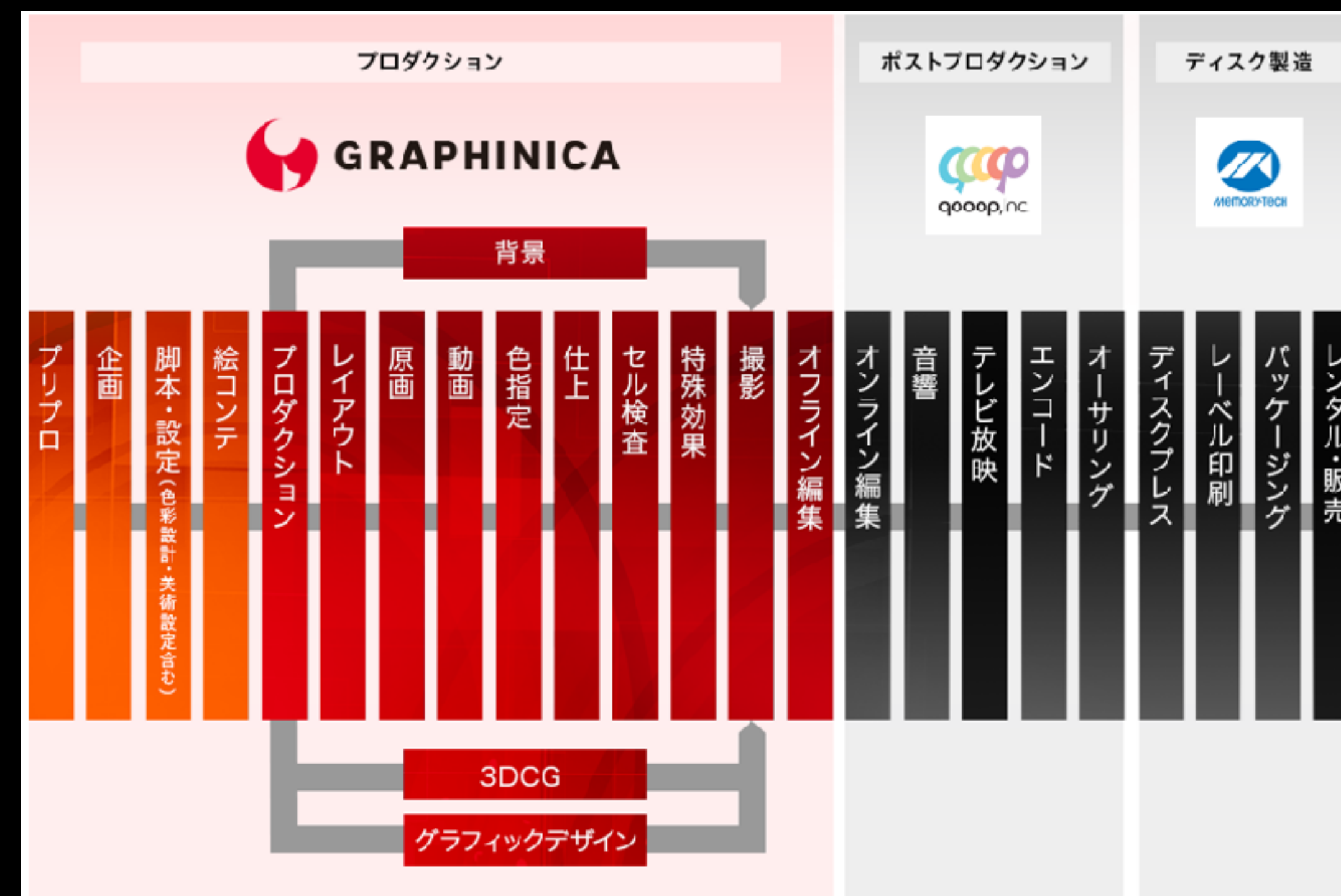


- 3DCGをはじめとするデジタル技術を武器とした新しいスタイルの総合デジタルスタジオ

A Japanese animation studio particularly promoting digital technology such as 3DCG

- 新しいアニメ表現を切り拓くための技術開発を推進

Advancing technology to explore new dimensions in anime expression



<https://www.graphinica.com/service/>

アニメーション映像制作のほぼ全ての制作プロセスを社内でカバー可能

Almost all the steps in animation production can be covered

3年前のSIGGRAPH Asia 2021で挙げられた課題
Challenges Discussed in SIGGRAPH Asia 2021

SIGGRAPH Asia 2021時点での課題 / Challenges discussed in 2021

- R&Dの狙い：生産性向上のためのR&Dまでに限定
Goals of R&D: Limited to R&D focused on productivity
- R&Dの機会：R&Dと連動する作品制作の機会
R&D opportunities: Production opportunities associated to R&D
- R&Dチーム編成：効果的にR&Dを実施するチームを編成する方法
R&D team assembling: How to assemble an effective R&D team
- 成果発信：学術界に向けたR&D成果発信の必要性
Outreaching: Need communicating R&D outcomes to the academia

R&Dの狙い / Goals of R&D

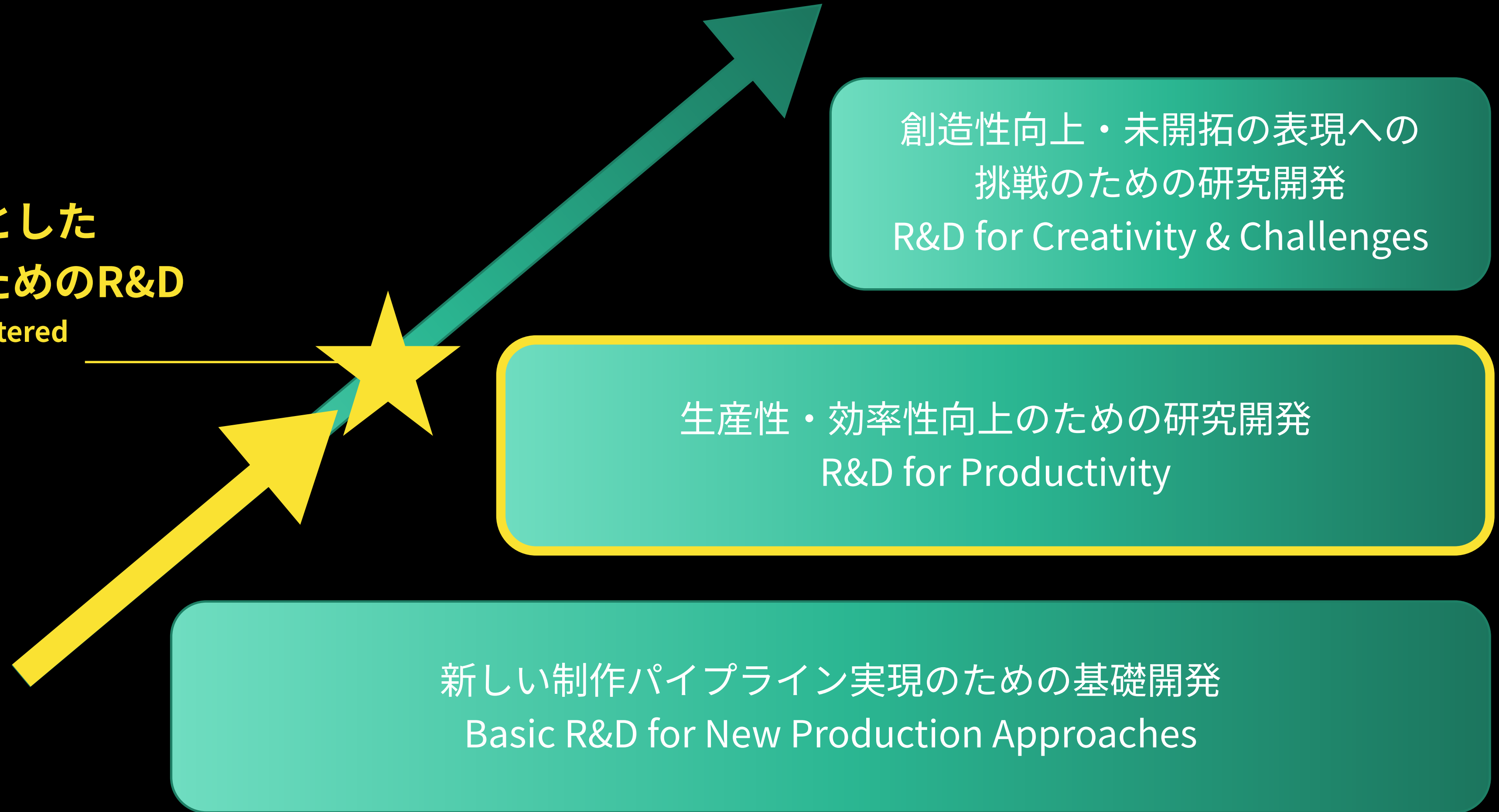
課題：生産性向上のためのR&Dまでに限定

Challenge: Limited to R&D focused on productivity

2021年時点

As of 2021

**ゲームエンジンを軸とした
制作パイプライン実現のためのR&D**
R&D for a game engine-centered
production pipeline



現時点での到達点

Achievement

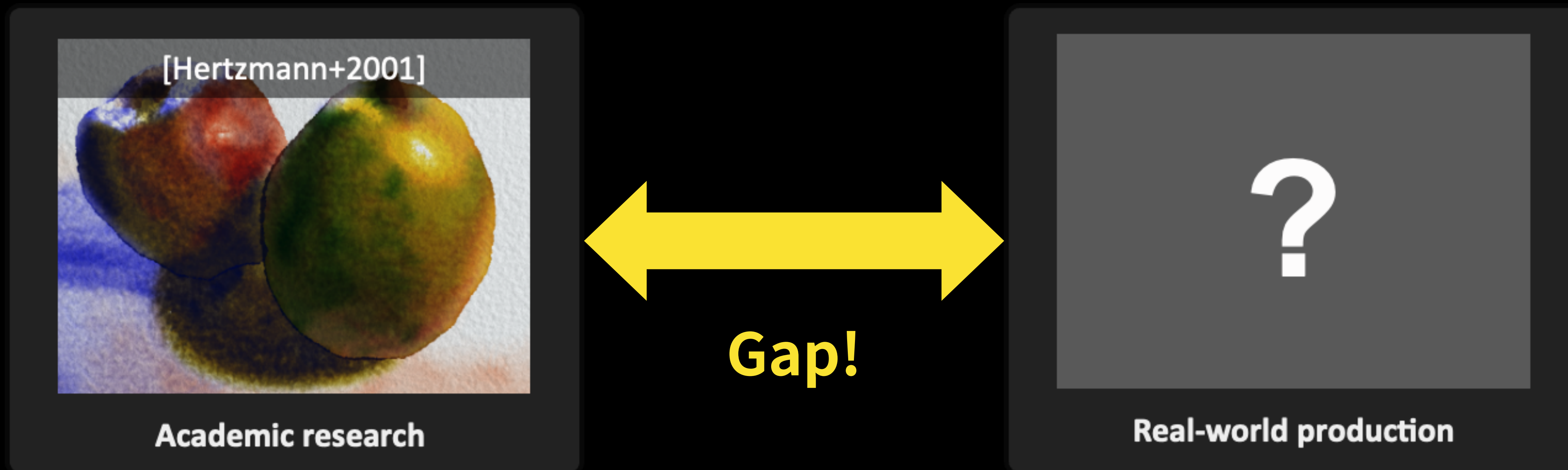
スタイル転写技術による
新しいアニメ表現の模索
Exploration of new anime expressions
by style transfer

創造性向上・未開拓の表現への
挑戦のための研究開発
R&D for Creativity & Challenges

生産性・効率性向上のための研究開発
R&D for Productivity

新しい制作パイプライン実現のための基礎開発
Basic R&D for New Production Approaches

スタイル転写によるアニメ表現の開拓 / Towards New Anime Expressions with **Style Transfer**



スタイル転写は長く研究されている [Hertzmann+01] が、映像プロダクションでの活用事例に乏しく、**学术界と現場に技術的なギャップ**があった

Although style transfer has been studied long [Hertzmann+01], its application in film production remains scarce, highlighting **a technical gap** between academia and the industry.

スタイル転写によるアニメ表現の開拓 / Towards New Anime Expressions with Style Transfer

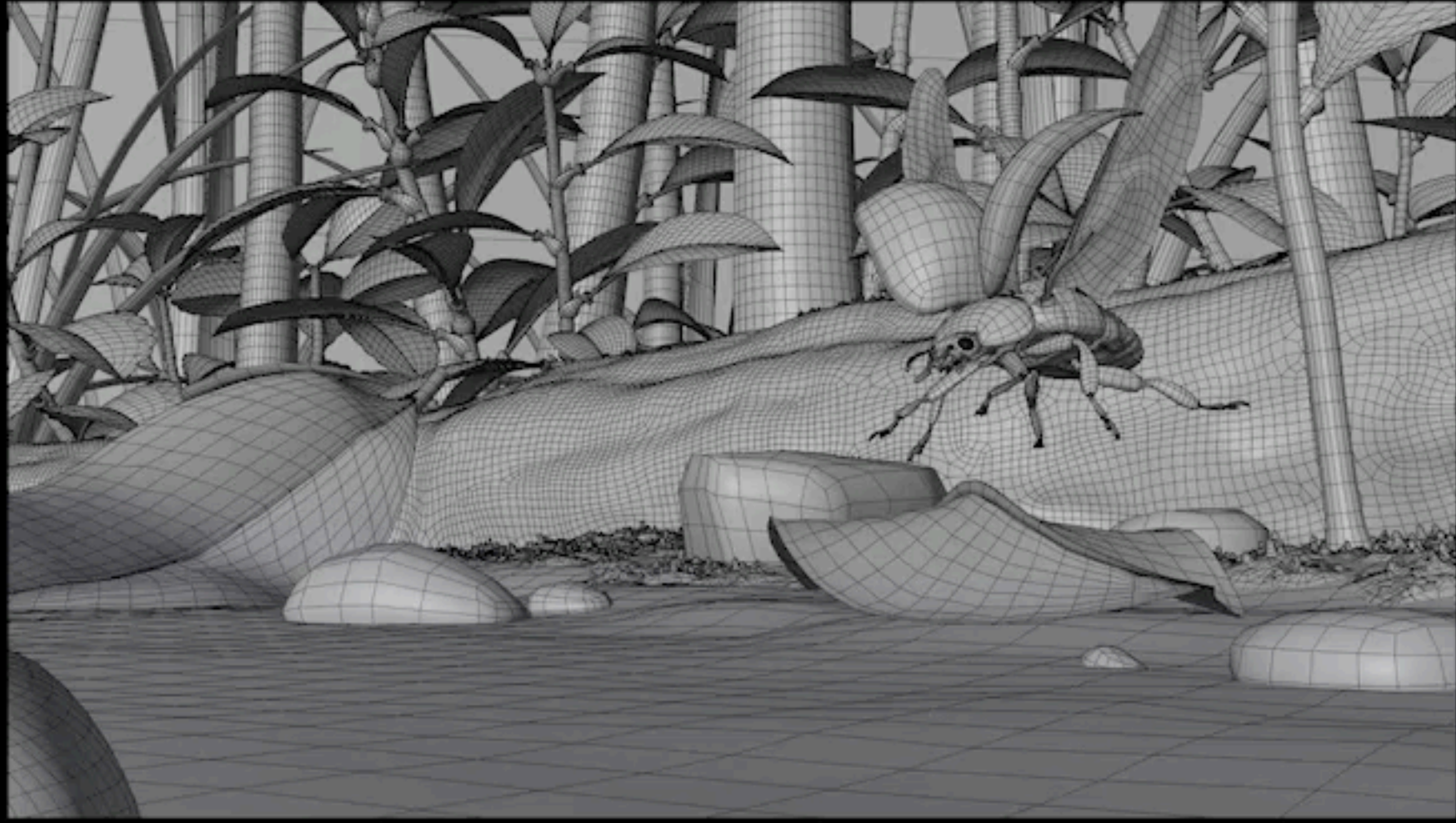
- 実際のプロダクションでの要求（アーティスト制御、シーン複雑性など）に応える現実的なパイプラインを検討して開発した

We developed a practical pipeline to meet the demands of real-world production, such as artist control and scene complexity.

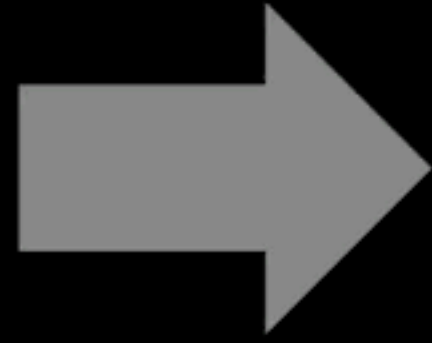
- 水彩画・油彩画など、これまでは表現が難しかった様々な手描き風スタイルの3Dアニメーションを実現にした

Our pipeline makes it possible to achieve 3D animations with diverse hand-drawn styles that were previously challenging to express (including watercolor and oil painting).





3D animated scene



**Style
transfer**

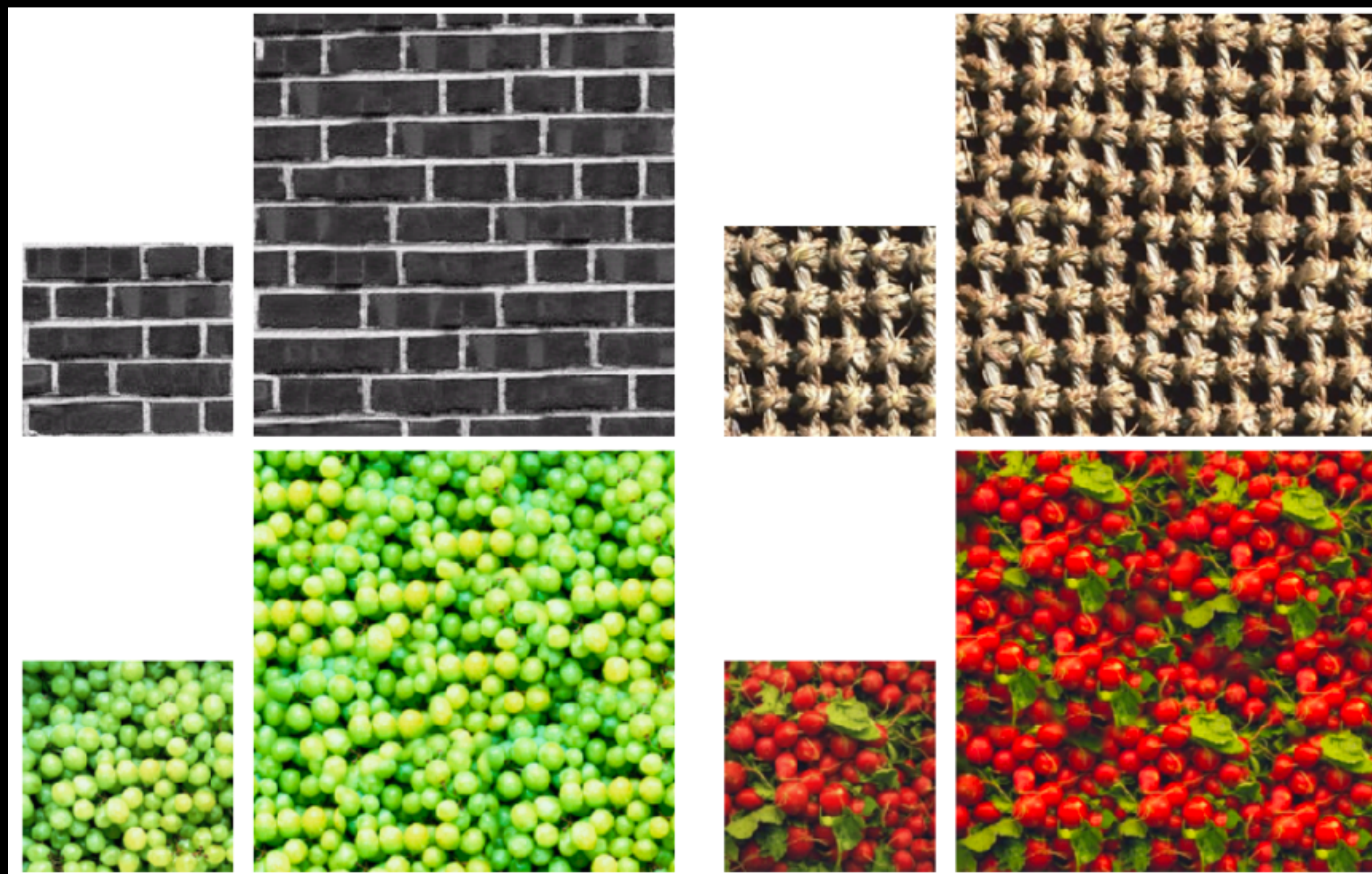


Style transfer result
(will be used in the composite stage)



2D style exemplar
(hand-drawn)

古典的な画像処理を採用 / Adoption of Classical Image Processing



古典的なテクスチャ合成 [Kwatra+05]

A classical texture synthesis approach [Kwatra+05]

- 細かなアーティスト制御で有利
Provides an advantage with fine-grained artist control
- 機械学習でないため学習データを必要とせず、安心して利用可能
Does not rely on machine learning, eliminating the need for training data and ensuring comfort in use

R&Dの機会 / R&D Opportunities

課題：R&Dと連動する作品制作の機会

Challenge: Production opportunities associated to R&D

実験的短編映像の制作 / Experimental Short Film

- **課題：技術を作る・検証する機会がない**
Challenge: Opportunities to develop/validate technologies
 - モデルケース：Pixarによる短編映像制作
Model case: Pixar's short film projects
 - 「技術をつくりながら絵をつくる」
"Creating art while developing technology"
- **実際にR&D成果をもとにショート映像を制作**
Produced a short film based on R&D outcomes
 - 実際の映像制作で使えるレベルでツール開発
Refined the tools to the level for real-world production settings



"Forest Tale"



チーム編成 / Team Assembling

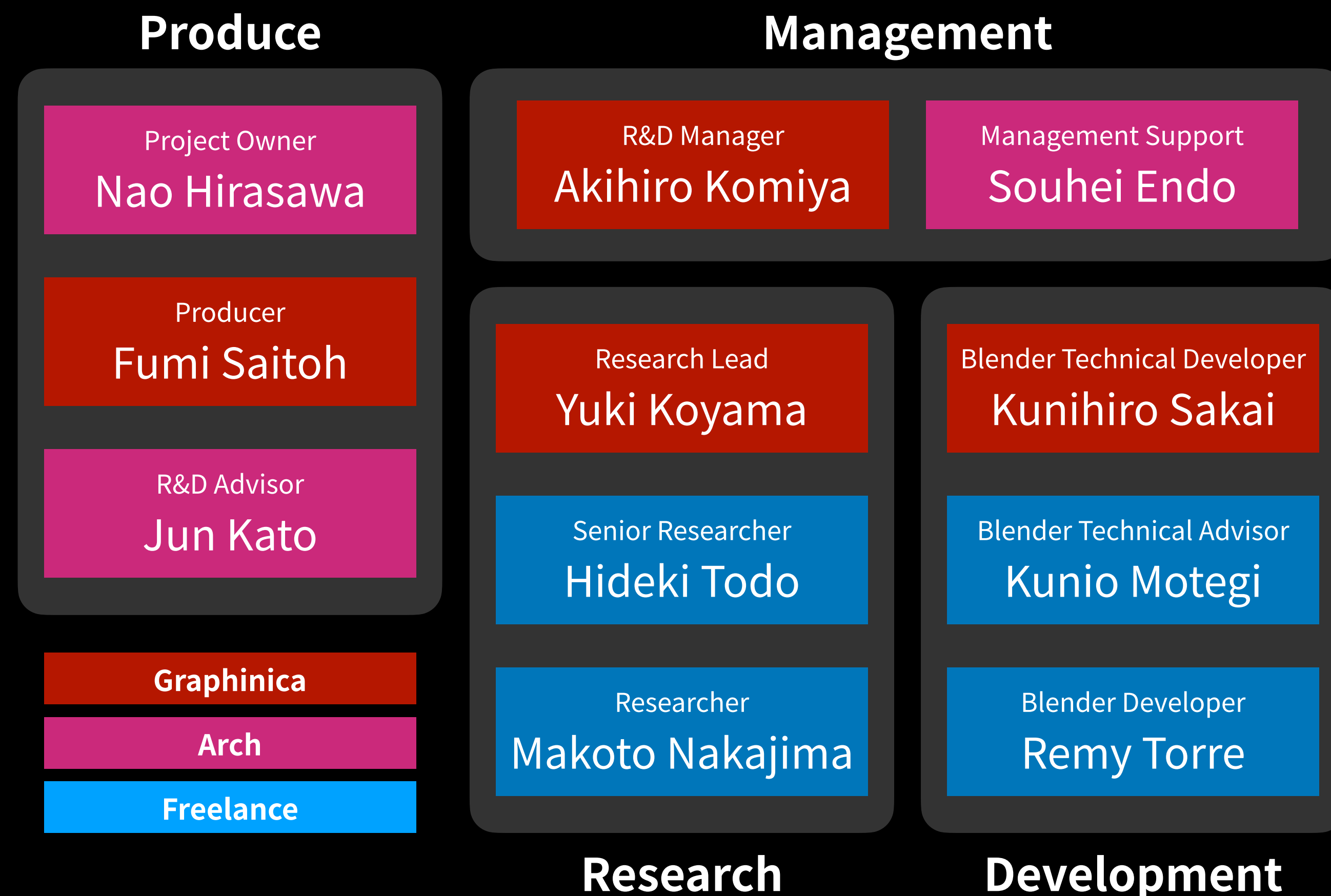
課題：効果的にR&Dを実施するチームを編成する方法

Challenge: How to assemble an effective R&D team

R&Dチームを編成する難しさ / Challenges of assembling an R&D team

- **アニメ業界はまだまだ情報技術系人材が圧倒的に少ない**
The anime industry still has an overwhelming shortage of tech people
 - 会社にR&Dの部署がないのが一般的
It is common for anime companies not to have R&D departments
- **アニメR&Dを行うには、現場とアーティストへの理解がなにより大事**
Understanding the production environment and artists is essential for conducting anime R&D
 - 安直な産学連携や非アニメのテック企業との連携で成功するのが難しい
It is difficult to achieve success through superficial industry-academia collaboration or partnerships with non-anime tech companies

実験的なR&Dチーム編成 / Experimental R&D Team Assemble



- 社内部署間・会社間の垣根を越え、さらにフリーランスを加えた少人数チームを結成

Formed a small team that bridges departments, companies, and freelancers

- “言葉”が通じるメンバーで構成
- Consists of members who can speak the same "language"

- 特に研究者はアニメ制作に精通し、アーティストの理解者であることが重要（これが難しい）

Researchers must be familiar with anime production and empathetic to artists

R&D成果発信 / R&D Outreach

課題： 学術界に向けたR&D成果発信の必要性

Challenge: Need communicating R&D outcomes to the academia

最近のR&D成果発信 / Recent R&D Outreach

- Visual Computing 2024 Posters

- VCポスター一賞 / VC Poster Award
- 優秀研究発表賞 / CGVI Award

- SIGGRAPH Asia 2024 Technical Communications



A Practical Style Transfer Pipeline for 3D Animation: Insights from Production R&D

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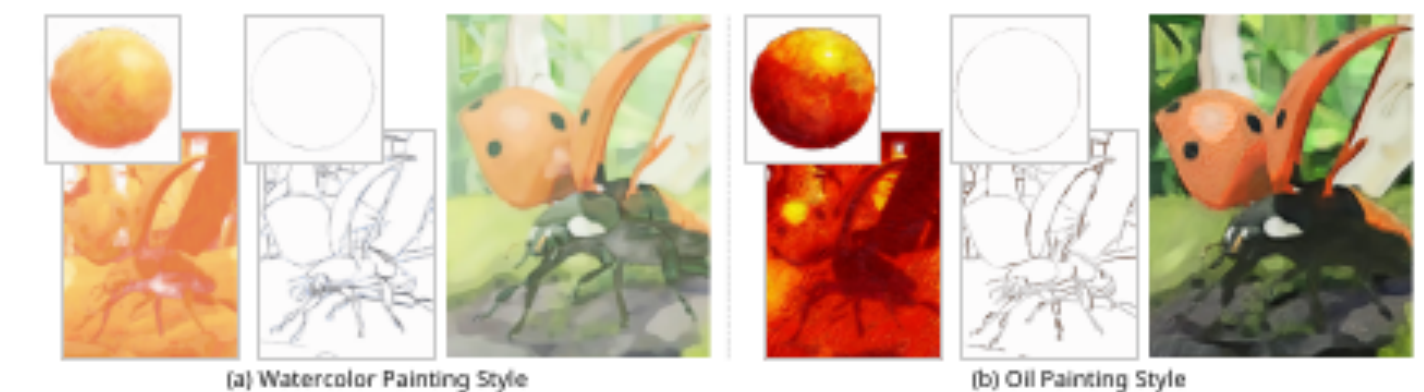


Figure 1: Style variations generated by our style transfer pipeline: (a) watercolor and (b) oil painting styles. We use style transfer to generate intermediate results (base touch and outline layers), which are then used to produce high-quality final compositions.

Abstract

Our animation studio has developed a practical style transfer pipeline for creating stylized 3D animation, which is suitable for complex real-world production. This paper presents the insights from our development process, where we explored various options to balance quality, artist control, and workload, leading to several key decisions. For example, we chose patch-based texture synthesis over machine learning for better control and to avoid training data issues. We also addressed specifying style exemplars, managing multiple colors within a scene, controlling outlines and shadows, and reducing temporal noise. These insights were used to further refine our pipeline, ultimately enabling us to produce an experimental short film showcasing various styles.

CCS Concepts

• Computing methodologies → Non-photorealistic rendering.

Keywords

Production R&D, Style Transfer, Non-Photorealistic Rendering

ACM Reference Format:

Hideki Todo, Yuki Koyama, Kunihiro Sakai, Akihiro Komiya, and Jun Kato. 2024. A Practical Style Transfer Pipeline for 3D Animation: Insights from Production R&D. In SIGGRAPH Asia 2024 Technical Communications (SA Technical Communications '24), December 3–6, 2024, Tokyo, Japan. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/3681758.3698900>

1 Introduction

Goals. In the pursuit of practical non-photorealistic rendering (NPR) techniques suitable for actual production, our animation studio has conducted research and development (R&D) on a production pipeline for creating stylized 3D animation (see Figure 1 for results). To support artistic creativity, we set the following goals:

- **Expression augmentation:** Enhancing artistic expression of 3D animation, particularly for animating the unique and diverse touches of 2D hand-drawn art (e.g., watercolor and oil paintings).
- **Complex scene suitability:** Handling intricate production scenes with many objects and materials, bridging the gap between academic research and real-world production.
- **Artist control:** Providing high artist control over the process, such as generating intermediate outputs that are usable

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SIGGRAPH Asia 2024
Technical Communications

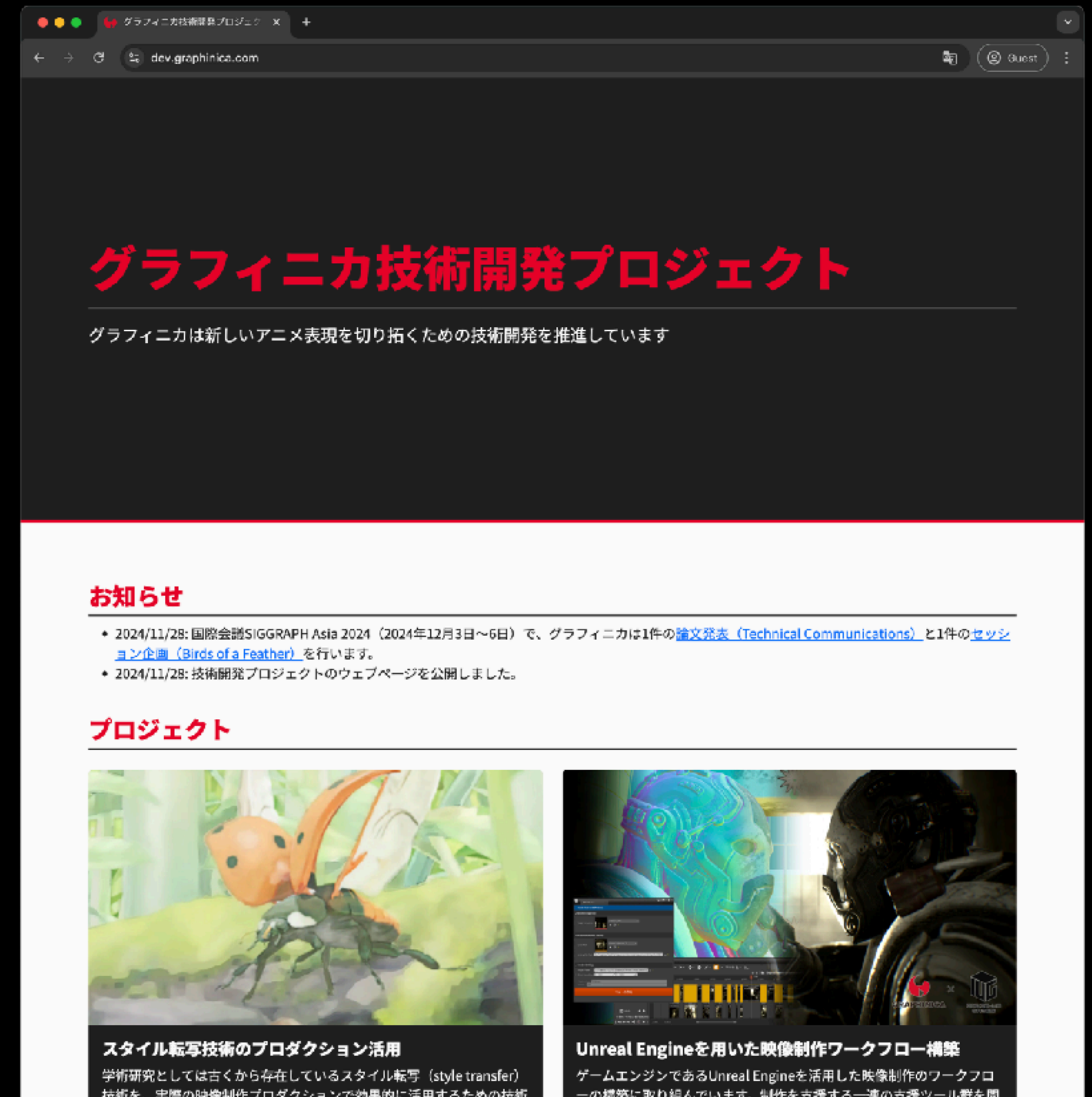
Best Paper Award!

ウェブサイト新設 / Website Release

- グラフィニカにおける技術開発情報を集約して情報発信するウェブサイトを新設

Launched a new website to share R&D info from Graphinica

- <https://dev.graphinica.com/>



まとめ / Summary

まとめ：この3年間での達成 / Summary: Achievements in These 3 Years

- 新しいアニメ表現を切り拓く **創造性向上**のためのR&Dを実施
Conducted R&D to **enhance creativity** and pioneer new forms of anime expression
 - **スタイル転写**技術を用いた制作パイプラインの構築
Developed a production pipeline utilizing **style transfer** technology
- 実験的なショート映像の制作 / Produced an experimental short film
 - **実際のプロダクションの要求レベル**を見据えたR&Dを実施
Conducted R&D with a focus on **meeting the demands of actual production settings**
- 実験的なR&Dチームの編成 / Formed an experimental R&D team
 - 外部人材を含めて **多様な背景を持ちつつ共通言語を持つ少数精鋭チーム**を編成
Assembled **a small, expert team with diverse backgrounds**, including external talent, united by a shared language
- R&D成果発信 / Outreaching R&D outcomes
 - SIGGRAPH Asia 2024 Technical Communicationsで発表 (**Best Paper Award** 🏆)
Presented at SIGGRAPH Asia 2024 Technical Communications (**Best Paper Award** 🏆)