FouRA: Fourier low-Rank Adaptation

Shubhankar Borse, Shreya Kadambi, Nilesh Prasad Pandey, Kartikeya Bhardwaj, Viswanath Ganapathy, Sweta Priyadarshi, Risheek Garrepalli, Rafael Esteves, Munawar Hayat, Fatih Porikli

Shubhankar Borse

Staff ML Researcher, Qualcomm AI Research

@qualcomm

Agenda

Introduction/Motivation
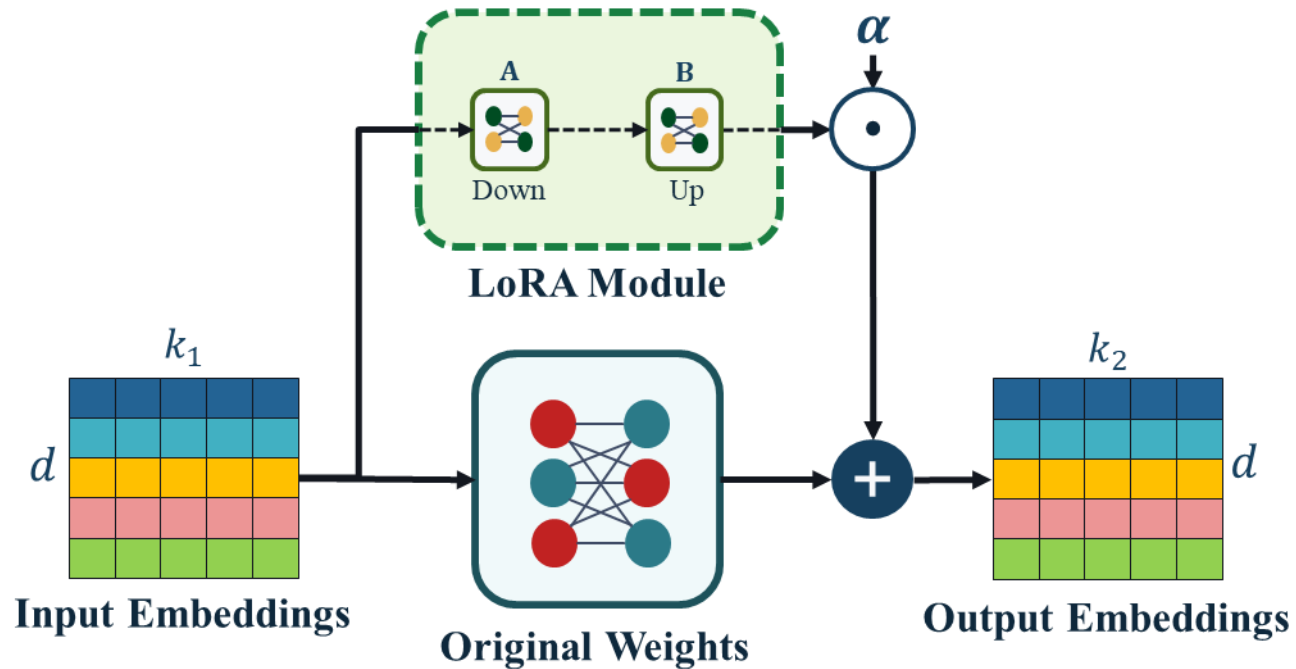
Proposed Approach

Interpretations and Analysis

Results

Conclusion

Introduction/Motivation

Low Rank Adaptation

LoRA
- Parameter-efficient fine-tuning
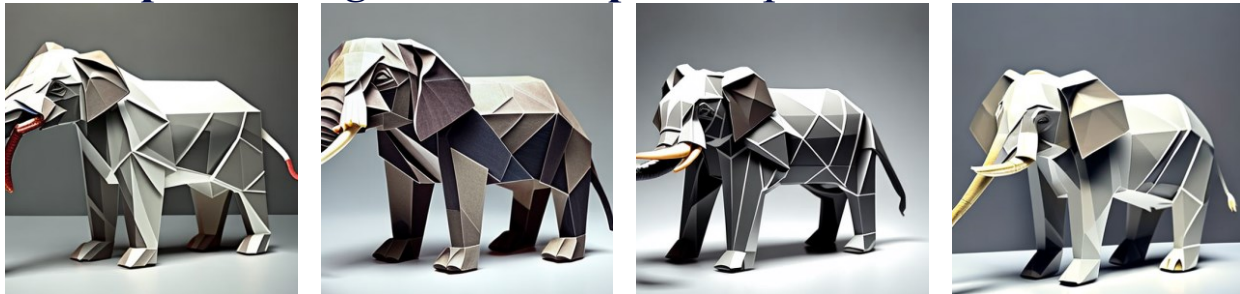- Parallel branch to network weights
- Transform to a low-rank subspace

Low Rank Adaptation: Distribution Collapse

LoRA faces distribution collapse or data-copying artifacts.

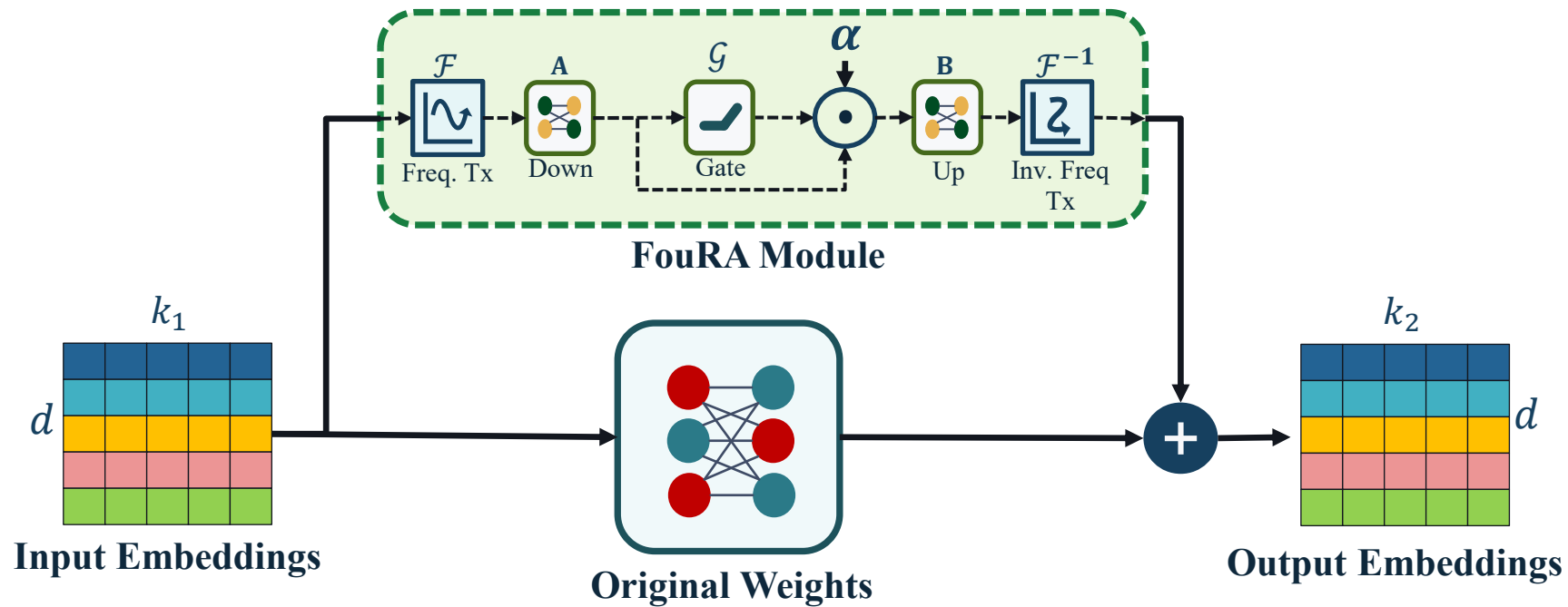**a. Adapter:** *"BlueFire"*, **Prompt:** "Fantastical Forest Witch"

b. Adapter: *"Origami"*, **Prompt:** "Elephant"

Proposed Approach: FouRA
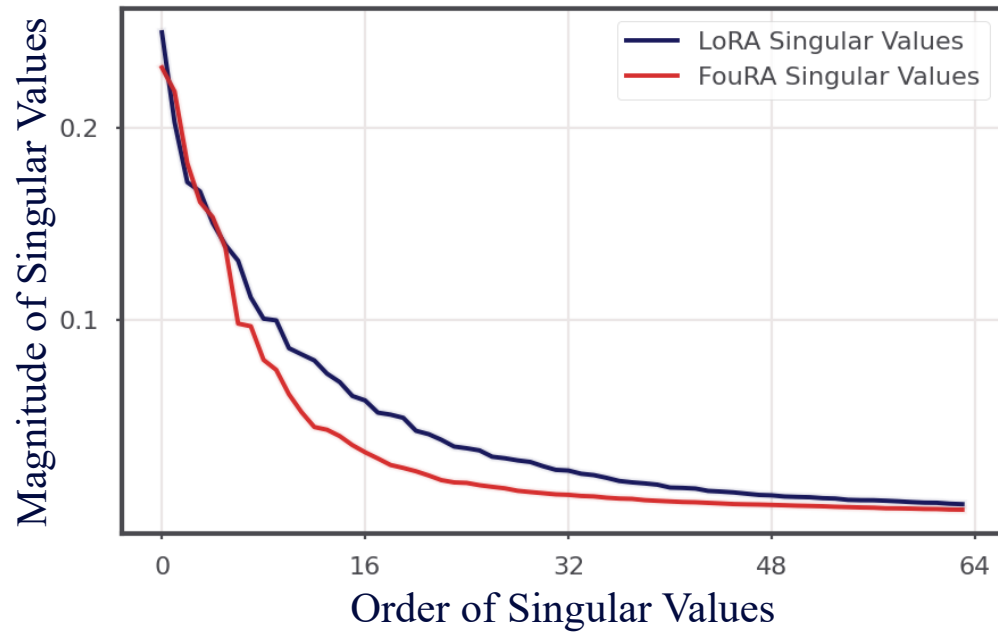
FouRA: Fourier Low-Rank Adaptation

FouRA Module
- Frequency Transform
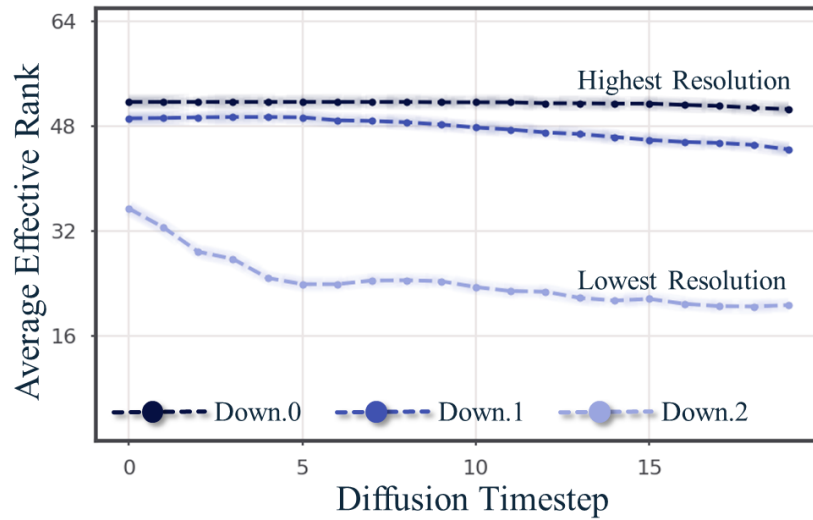- Inference Adaptive Gating

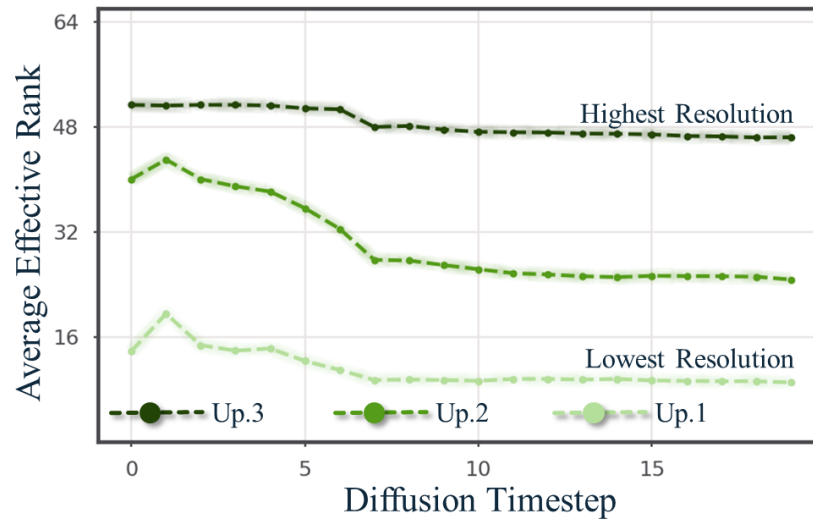# Interpretations and Analysis

Compactness in the Fourier domain

Singular Value Spread
- Compactness
- Decorrelation

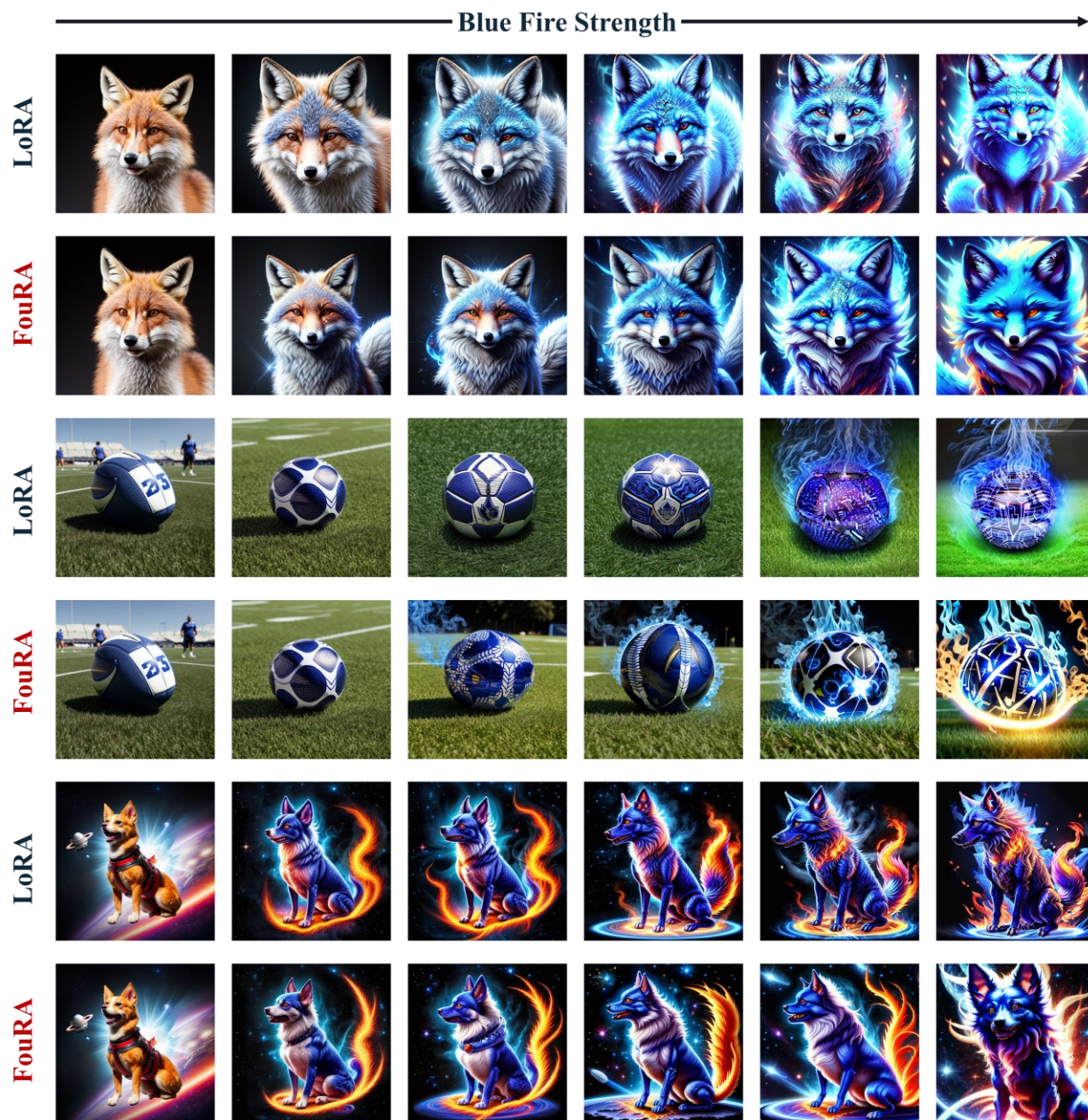# Average Effective Rank

a) FouRA UNet Downsampling Blocks

b) FouRA UNet Upsampling Blocks

Average Effective Rank
- Increases as resolution increases
- Reduces as diffusion timestep increases

Results

FouRA for Text-to-Image stylization

Text-to-Image stylization
- Base model: SD1.5
- Adapter: Blue Fire
- Prompts (top to bottom): Fox, Football, Dog in space.

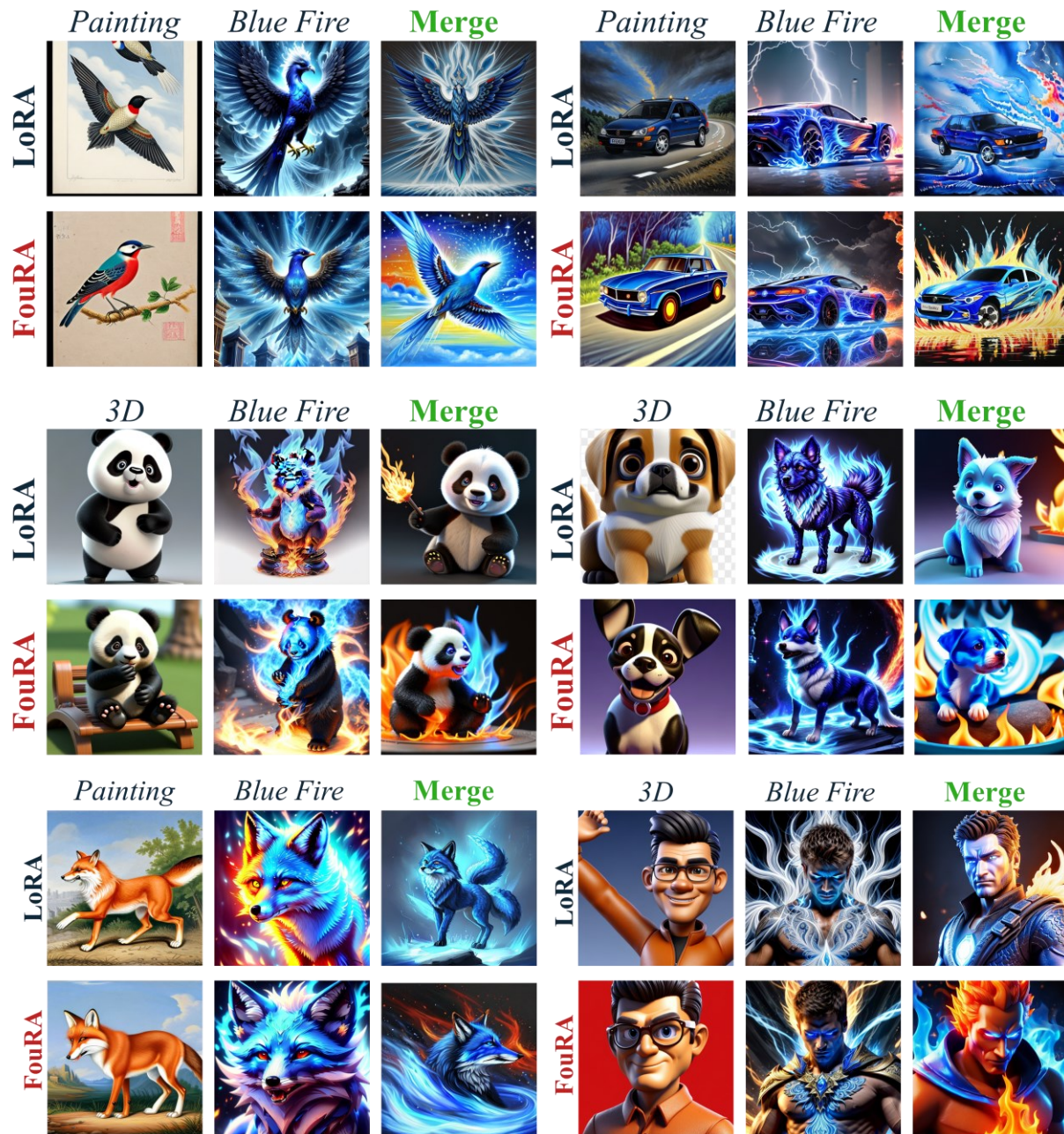# FouRA for Text-to-Image stylization

Adapter	Fourier	Frozen Dynamic Mask	Inf-Adaptive Mask	HPS ($\uparrow$)	LPIPS-Diversity ($\uparrow$)
LoRA				27.7	37.8
Frozen Mask		✓		28.2	38.9
Inference-Adaptive Mask			✓	28.7	39.7
FouRA (No Mask)	✓			30.0	43.2
FouRA (Frozen Mask)	✓	✓		30.3	44.0
FouRA (Inference-Adaptive Mask)	✓		✓	**30.6**	**44.5**

Text-to-Image stylization
- Base model: SD1.5
- Adapter: Paintings
- HPS: For prompt alignment and aesthetic quality
- LPIPS-Diversity: Diversity across 30 seeds

FouRA for Merging Adapters

Merging Adapters
- Base model: SD1.5
- Weighted addition of adapter outputs.
- FouRA can effectively merge two styles.

FouRA with concept sliders

Conclusion

Thank you

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