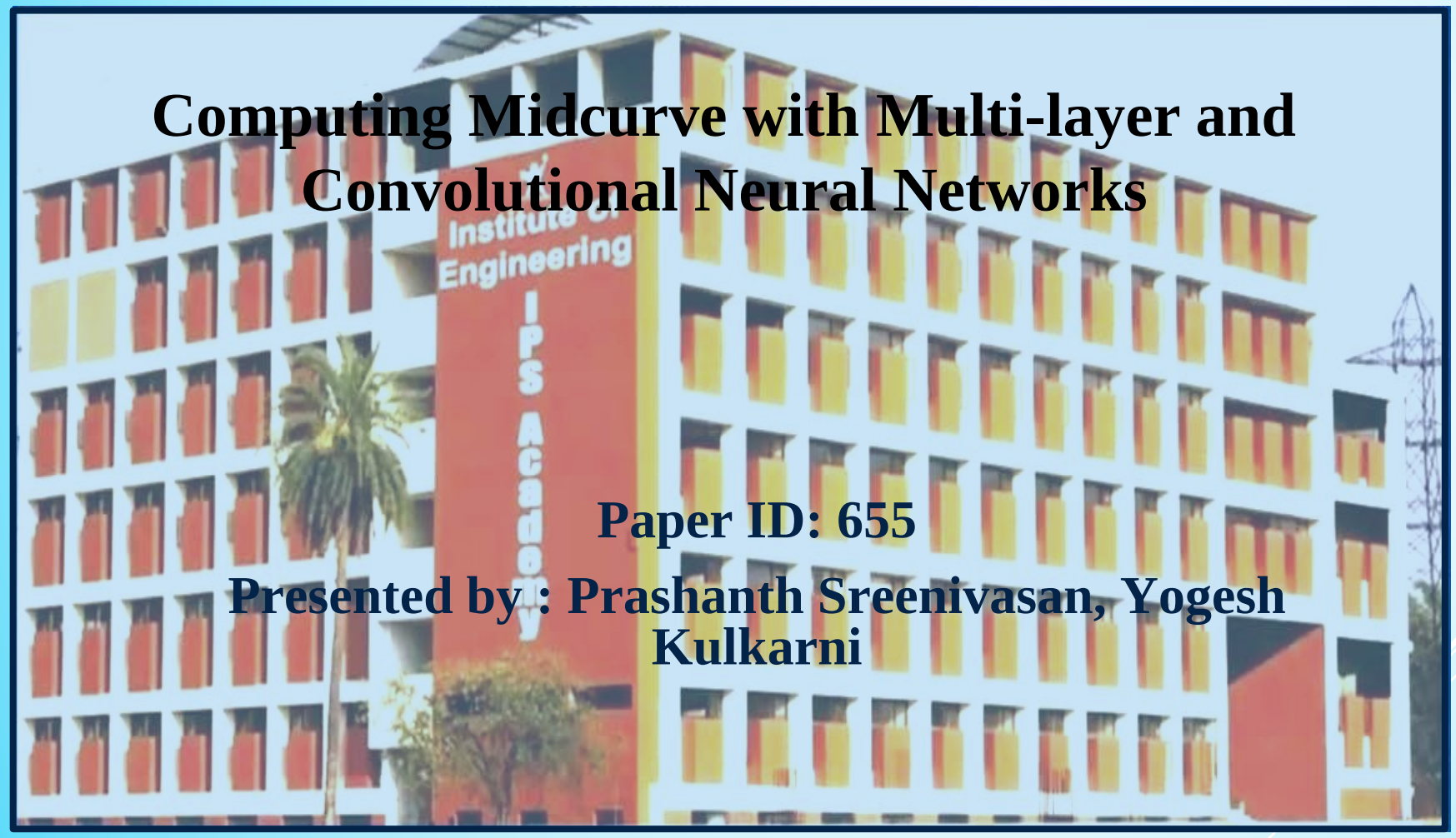
Department of Computer Science & Engineering
IPS Academy, Institute of Engineering & Science
Indore

Computing Midcurve with Multi-layer and Convolutional Neural Networks



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PAPER TITLE

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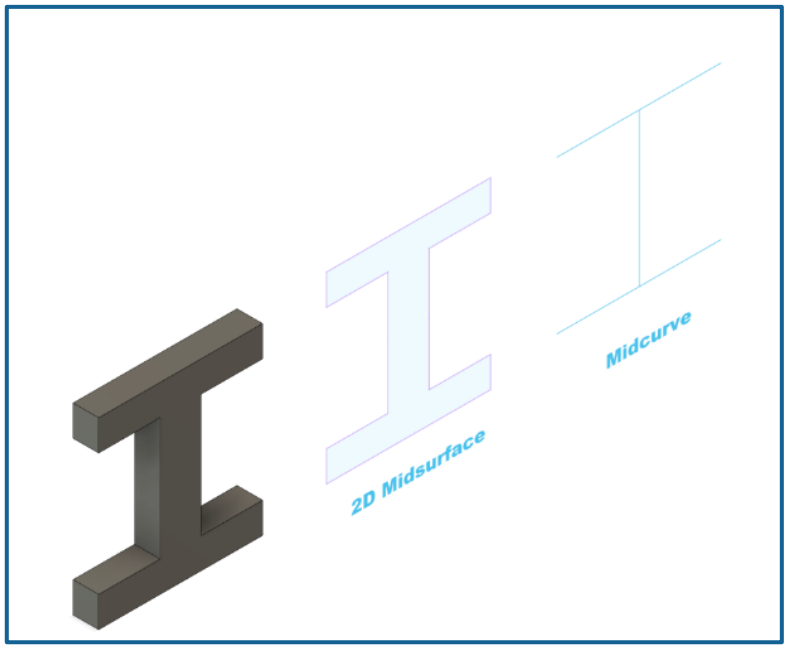
OVERVIEW

Abstract

- Midcurve computation: dimension reduction from 2D to 1D
- Applications in CAD/CAE and robot path planning
- Two new neural architectures:
  - Multi-layer dense network
  - CNN-based architecture with skip connections
- Key achievement: Tenfold reduction in average loss

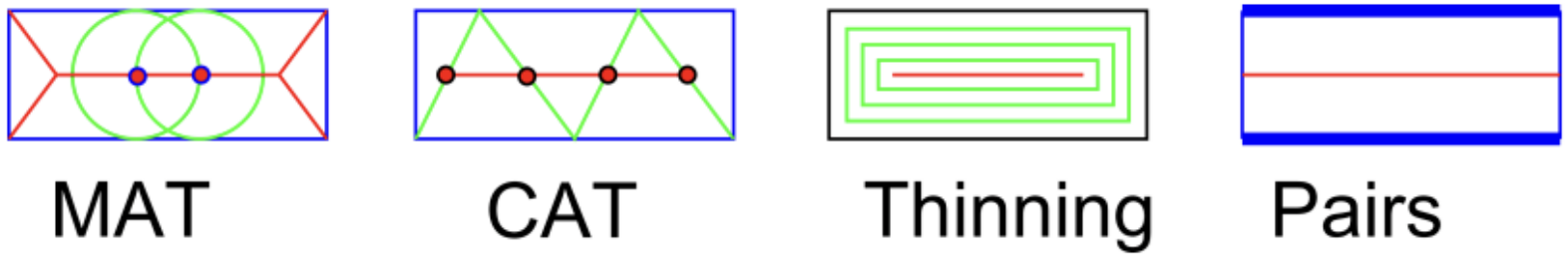
Introduction

- What is Midcurve?
- Why is it important?
- Applications: • FEA • Robot path planning • Character animation



Literature/Related Work

- Traditional Methods:
  - MAT (Medial Axis Transform)
  - CAT (Chordal Axis Transform)
  - Thinning-based methods
- Limitations of existing approaches

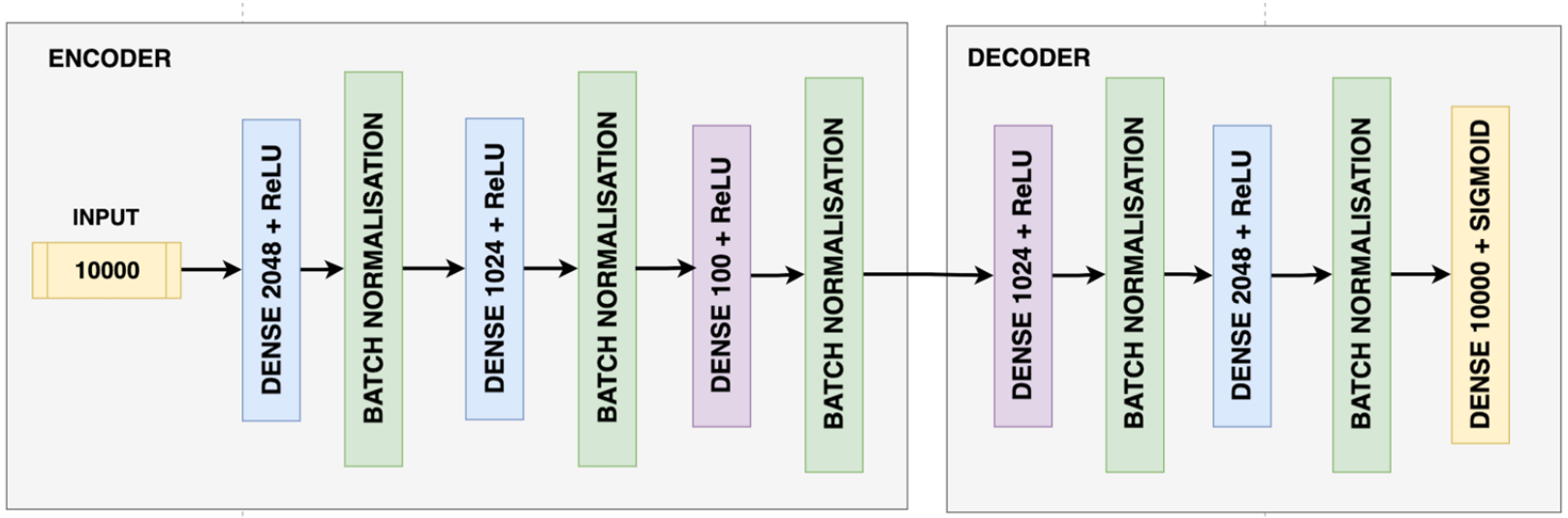


Methodology

- Image-based representation
- Two proposed architectures:
  - Dense Network
  - CNN with skip connections
- Data preprocessing: 128x128 pixels

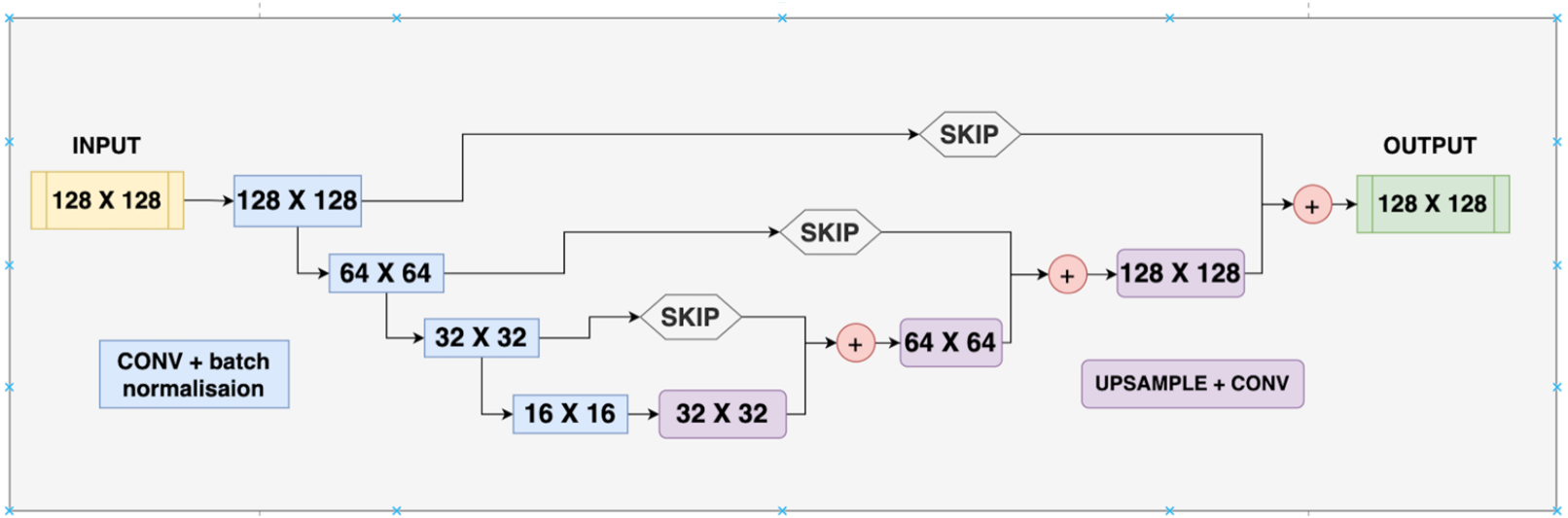
Dense Network Architecture

- Gradual dimension reduction
- Multiple dense layers
- ReLU activation
- Symmetric encoder-decoder



CNN Architecture

- 4 convolutional blocks
- Skip connections
- Batch normalization
- Dynamic learning rate



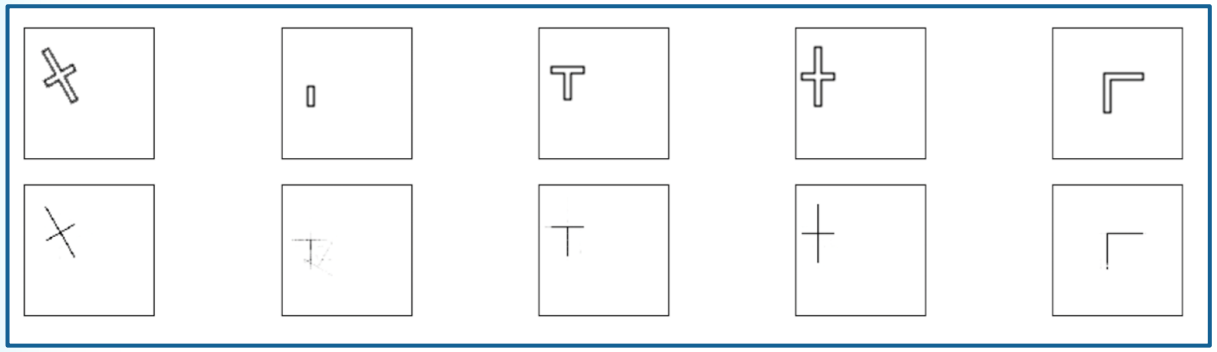
Results

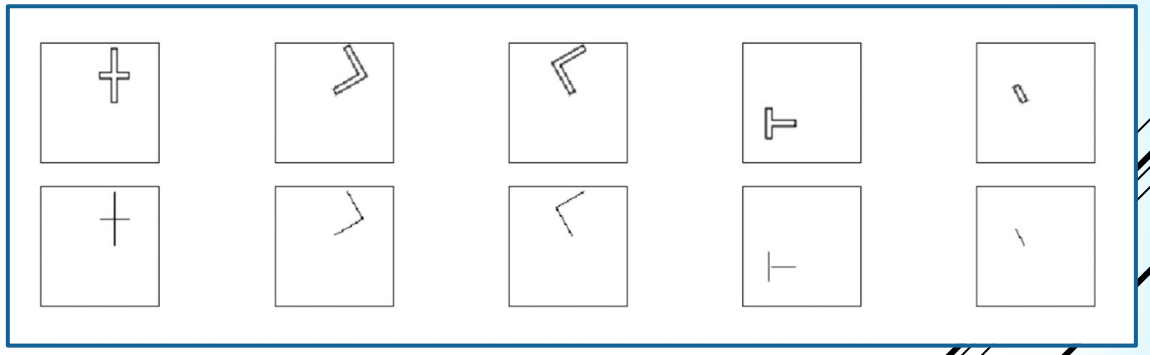
- Performance Metrics
- Comparative Analysis

Metric	Simple	Dense	CNN
Best Epoch	100	62	93
Training Loss	0.0034	0.0049	**0.0003**
Training MAE	0.0023	0.0032	**0.0003**
Validation Loss	0.0080	0.0121	**0.0005**

Visual Results

- Input shapes
- Generated Midcurves
- Quality comparison





Conclusion

- CNN architecture performs best
- 10x reduction in loss
- Improved geometric accuracy