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# ***Historical Advances and Ethical Aspects of 3D Mesh Reconstruction Diffusion Models***

## **Seminar Paper**

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# Historical Advances and Ethical Aspects of 3D Mesh Reconstruction Diffusion Models

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## ABSTRACT

### 1 INTRODUCTION

The field of Generative 3D AI is constantly improving, and the potential for future advancements is vast. One very promising direction is the generation of 3D models from single 2D images. This particular process is called 3D mesh reconstruction and could revolutionize asset creation in many fields as it improves. Some examples include the newly released TripoSR (Tochilkin et al. (2024)) or the more established Zero-1-to-3 (R. Liu et al. (2023)).

This paper explores the historical evolution of this rapidly evolving field as well as its ethical implications and general applications. Beginning with an overview of the historical development of these techniques, ranging from early methodologies to modern advancements, covering significant milestones that have shaped the entire subject. Including a deeper look into the inner workings of some models, like the underlying methods for generating and predicting radiance fields for the reconstruction. Furthermore, a small peek at 3D-model datasets like Objaverse-XL (Deitke et al. (2023)) and how they have influenced model training.

The examination of the applications of 3D mesh reconstruction across diverse domains, including development and entertainment, highlights the potential for innovation and advancement. However, it also raises crucial ethical concerns. Privacy considerations, issues of representation and cultural sensitivity, as well as the implications of estimations and hallucinations, highlight the complex ethical landscape surrounding these technologies.

## 2 HISTORICAL EVOLUTION

### 2.1 Models

In the recent years several models have been developed to generate 3D models from 2D images. Some of the most prominent models include:

#### 2.1.1 One-2-3-45

This model was developed by M. Liu et al. (2023)...

#### 2.1.2 Zero-1-to-3

Zero-1-to-3 is a model developed by R. Liu et al. (2023)...

#### 2.1.3 TripoSR

TripoSR is a model developed by Tochilkin et al. (2024)...



Figure 1: Models generated by One-2-3-45++ (M. Liu et al. 2023)

### 2.2 Comparison

Result comparison between models both visually and in terms of performance.

## 3 APPLICATIONS OF 3D MESH RECONSTRUCTION

As the field is still relatively new, no mainstream applications have been established yet. However, the potential is great and some possible applications have already been identified.

### 3.1 Development and Entertainment

The most prominent application of 3D mesh reconstruction could be in the development and entertainment industry. The ability to generate 3D models from 2D images could revolutionize the asset creation process. This could be especially beneficial for indie developers or small studios that do not have the resources to create high-quality 3D models from scratch. The generated models could be used in video games, movies, animations, and other forms of media. This could significantly reduce the time and cost associated with creating 3D assets, allowing developers and animators to focus on other aspects of their projects. (see Figure 1)

### 3.2 Medical

### 3.3 Other Applications

#### 3.3.1 Cultural Heritage

## 4 ETHICAL IMPLICATIONS

Even though all the advancements in the field of 3D mesh reconstruction are promising, they also raise quite a few concerns.

#### 4.1 Environmental Impact

Estimations of energy consumption for training as well as execution of models.

#### 4.2 Training Data

The sources of training data. Looking at datasets like Objaverse-XL (Deitke et al. 2023) and their sources.

#### 4.3 Privacy Concerns

#### 4.4 Cultural Sensitivity

It is important that the models are actually representative of the cultures, especially when generating models of people or culturally significant objects.

#### 4.5 Implications of Estimations and Hallucinations

It is usually necessary for these models to estimate not seeable parts of the object. This can lead to hallucinations and other artifacts in the generated models.

### 5 DISCUSSION AND FUTURE DIRECTION

Discussion of results and their implications. What are the limitations current works? What are the next steps in this research area?

### 6 CONCLUSION

#### REFERENCES

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