CLIP-IVP: CLIP-based Intraoral View Prediction Using Conditional GANs

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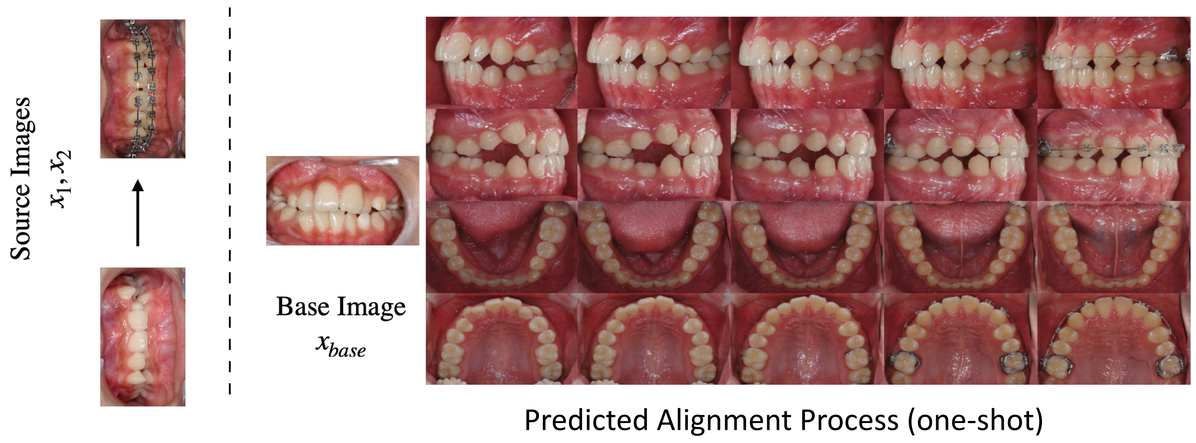
TL;DR

- ***We propose a novel method called CLIP-based Intraoral View Prediction (CLIP-IVP) for predicting novel views of intraoral structure using only a single front teeth image of a patient.***
- ***Our approach leverages pre-trained CLIP image encoder to represent front intraoral images in zero-shot manner, reducing time and resources for training.***
- ***Our model can also be used to predict the orthodontic treatment process in a one-shot manner, which might be useful in treatment planning and prediction.***



Predicted Alignment Process (one-shot)

Abstract

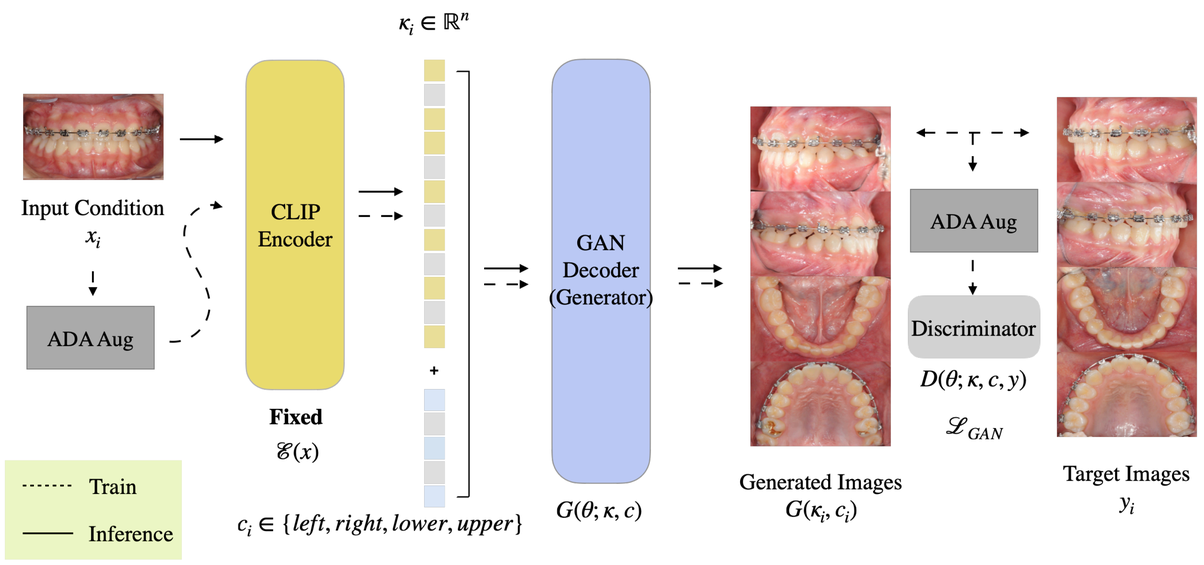
In this study, we propose a novel method called CLIP-based Intraoral View Prediction (CLIP-IVP) for predicting novel views of intraoral structure using only a single front teeth image of a patient. Our approach leverages pre-trained CLIP image encoder to represent front intraoral images, reducing time and resources for training. Our model achieves a Frechet Inception Distance (FID) score of 3.4 on the intraoral view prediction task. Our model can also be used to predict the orthodontic treatment process in a one-shot manner, which might be useful in treatment planning and prediction. The official implementation of our method is available on https://github.com/three0-s/clip-ivp.

Introduction

- While intraoral images play a pivotal role in orthodontics, obtaining a complete set of standardized intraoral images in real-world clinical settings remains challenging.
- Therefore, we propose a novel method called CLIP-based Intraoral View Prediction (CLIP-IVP) that utilizes a pre-trained CLIP image encoder to predict medically standardized full set of intraoral images from front intraoral images without additional clinical information.

Method

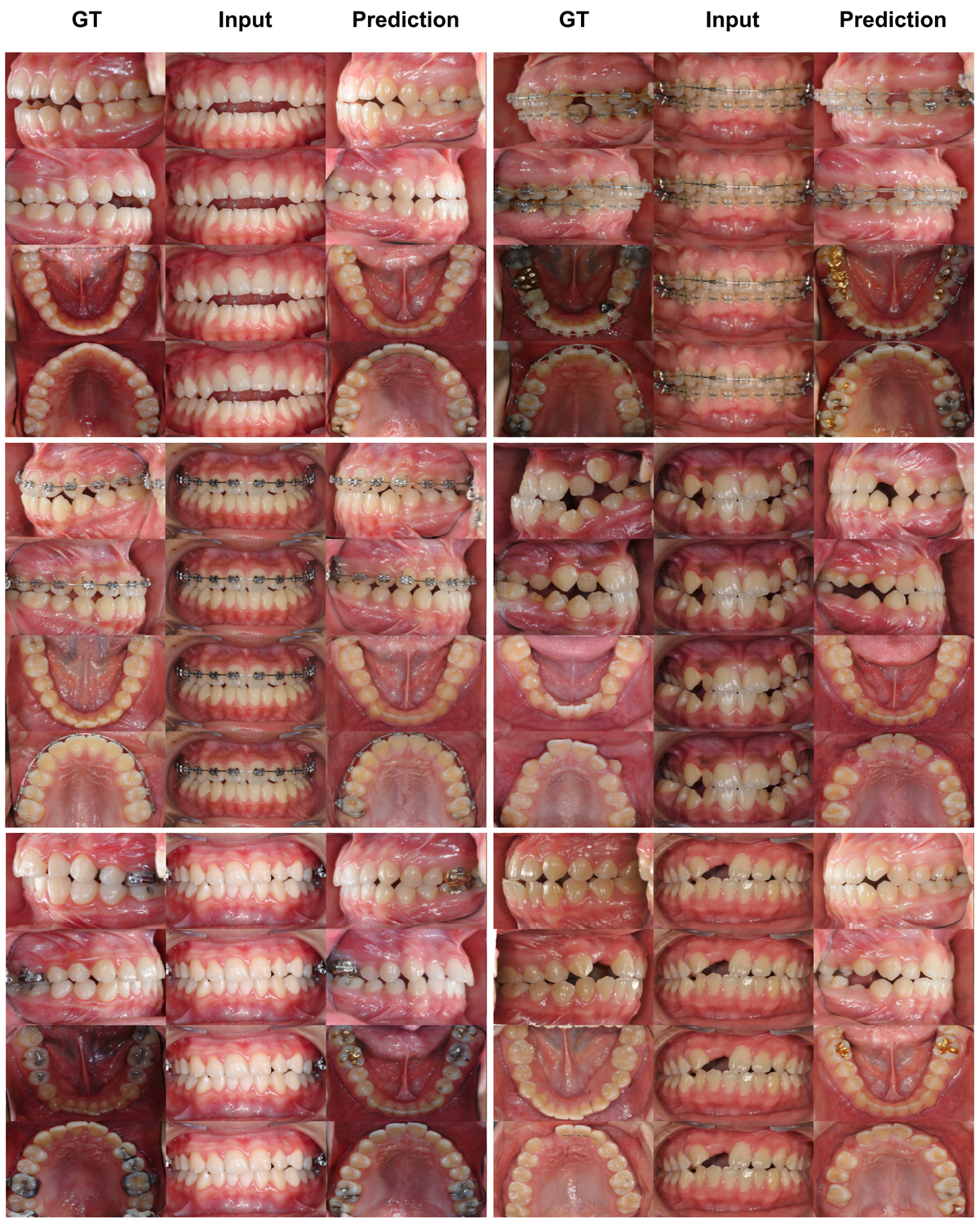
- Training dataset should include tuples (x_i, y_i, c_i), where x_i, y_i and c_i, respectively represents the front intraoral image, the corresponding view of intraoral structures, and the corresponding class label. By forwarding x_i through the CLIP image encoder, we obtain the corresponding CLIP image latent vector κ_i. During training, the decoder is conditioned on κ_i and c_i.
- Our CLIP Image latent decoder builds on the network proposed by Karras et al. [1].



Suggested network diagram.

Experiment

- We train our model using an internal dataset consisting of 7,000 pairs of intraoral images, while the test set and the validation set had 2,048 pairs and 512 pairs, respectively.
- We achieve an FID of 3.4 on image-to-image translation.
- By manipulating an image latent based on the disparity between pre-treatment and post-treatment image latent, our model can also be used to progressively predict the orthodontic treatment process of a patient using only a pair of source images.
- For one-shot *semantic nudge*, we manipulate the base image to reflect the semantic difference between a pair of source images, such as pre- and post treatment intraoral images. With semantic nudge, we can progressively predict the orthodontic treatment process of a patient. The predicted images show the process of leveling and alignment.



Conclusions & Acknowledgements

Our model provides a promising solution for intraoral view prediction and has the potential to improve the efficiency and accuracy of orthodontic treatment planning.

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References

[1] Karras, T., Laine, S., Aittala, M., Hellsten, J., Lehtinen, J., Aila, T.: Analyzing and improving the image quality of stylegan. In: Proceedings of the IEEE/CVF conference on computer vision and pattern recognition. pp. 8110–8119 (2020)