## TERMINOLOGY

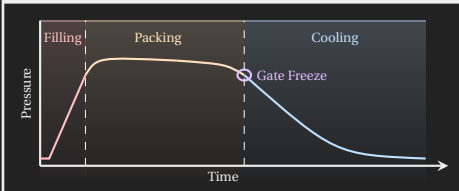
### WRITINGS

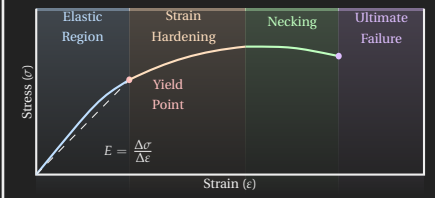
subsidiary: 附属的
groundbreaking: 开创性的
be incorporated into: 被纳入
essentially: 本质上
cylinder: 圆柱体
subsidiary: 附属的

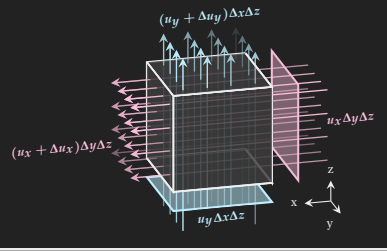
### PROFESSIONS

Morphable: 可变性的
Facial Re-enactment: 面部重现
illumination: 照明
3D Morphable Models: 3DMMs
groundbreaking: 开创性的
subsidiary: 附属的

## TIKZ DIAGRAMS




## INTRODUCTION

### DEFINITION

A 3D Morphable Face Model is a generative model for face shape and appearance that is based on two key ideas.
1. All faces are in dense point-to-point correspondence.
2. Separate facial shape and color and to disentangle these from external factors such as illumination and camera parameters.
3DMMs 最初是一个人脸分布的统计模型，后续引入了其他生成式学习模型。

### INTRODUCTION

3DMMs发展的前提假设是类别的先验知识对视觉任务很重要，被设计用于从一组样本中自动学习以捕获这样的先验知识。

## RESEARCH DEVELOPMENT

### I: EIGENFACES

1. **Eigenfaces [1987, 1991]**: explicit face representation and operated on gray levels, images of faces is a vector space and the eigenvectors represent variation in space. ——influential
**Drawbacks**: fixed pose and illumination, no shape differences.
2. **Eigenfaces in 3D [1996]**: model shading variations in 3D faces.

### II: CORRESPONDENCE-BASED

通过添加 2D 形状变换的特征分解得到明确的 shape model 和 aligned Eigenface model. 传统的 Eigenface 方法只对齐一个单独的点，而新的方法建立了大量点的对应。
3. **Landmark-based Face Warping [1991, 1995]**: a statistical shape model using landmarks. ——innovative
4. **Active Appearance Models [1998]**: a combination of shape and appearance. ——successful and influential
5. **Dense Pixel-wise Image Correspondences [1999, 1998]**: computed dense pixel-wise image correspondences with optic-flow algorithms for modeling the facial shape variations.
以上的 2D models 能够有效捕获对应于一个固定姿势和照明环境的形状变换，并可以拓展到姿势的变换、其他类别。且证实图像中形状和纹理信息的分离可以建模脸部的变化。引入姿势和照明环境变换代价高昂且条件受限，后续受益于 3D 图形学的发展，造就了 3DMMs 的诞生。

## ALGORITHMS

### EXTENDED

1. optic-flow algorithms 光流算法

# References

[1] Bernhard Egger, William A. P. Smith, Ayush Tewari, et al. 3d morphable face models—past, present, and future. *ACM Transactions on Graphics*, 39(5):1–38, 2020.

[2] Medical-Channel-910. Latex equations sheet template. 2024. Accessed: 2024-12-11.