Structured-light-based Stereo Vision

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Friday 08/12/2017

12:00PM (GMT+8)

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Outlines

- Introduction
- Algorithm
- Presentation and Evaluation
- References

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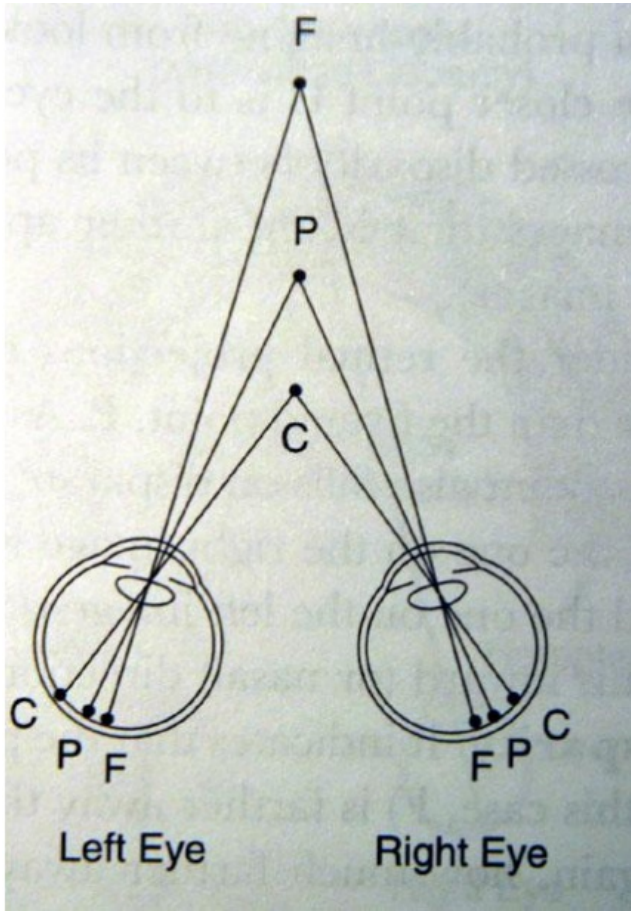
Introduction



Stereo Vision

Monocular camera can not obtain the depth of the points.

Human beings use two eyes to estimate the distance.

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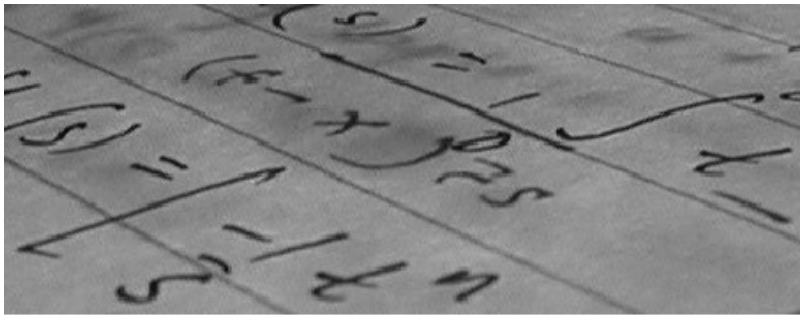
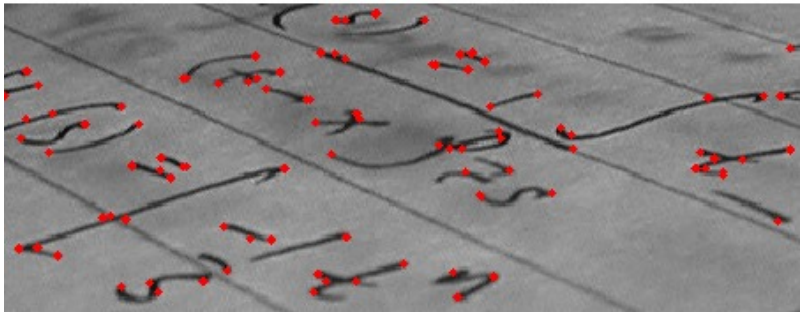
Introduction

feature points detection and matching





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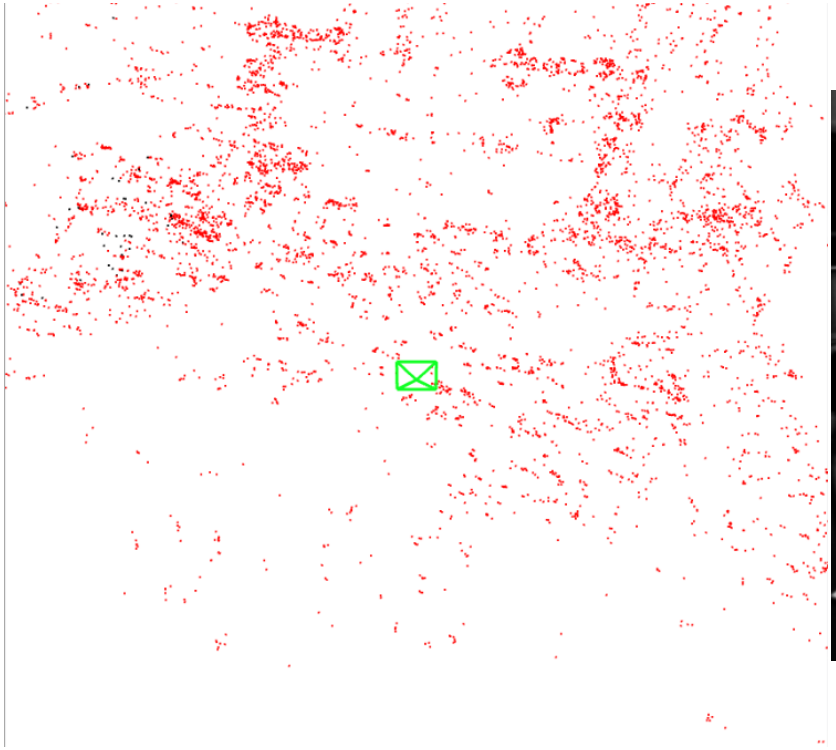
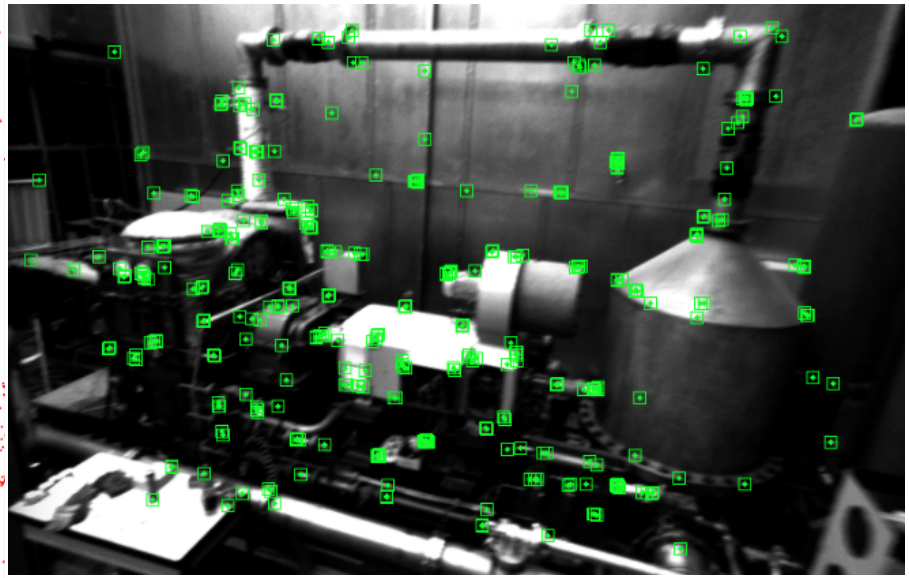
Introduction

feature points are not dense enough





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Introduction

characteristics and current situation of structured light system

- Detection range in depth: less than 5000mm
- Accuracy: 0.05mm
- Number of points per seconds: more than 100 thousands

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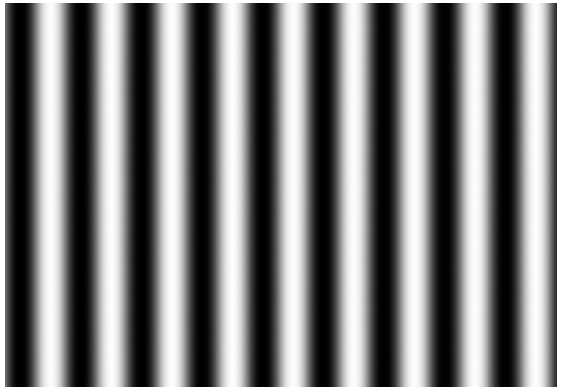
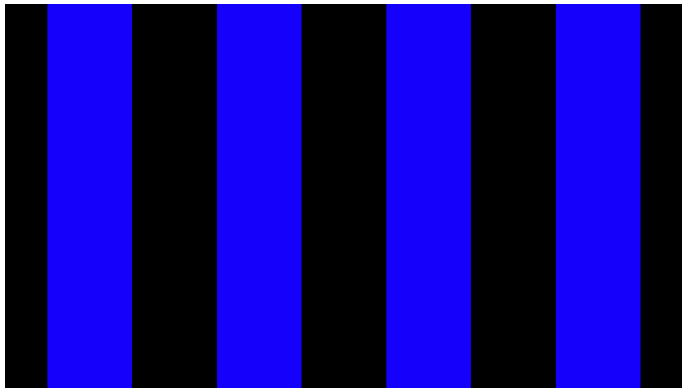
Algorithm

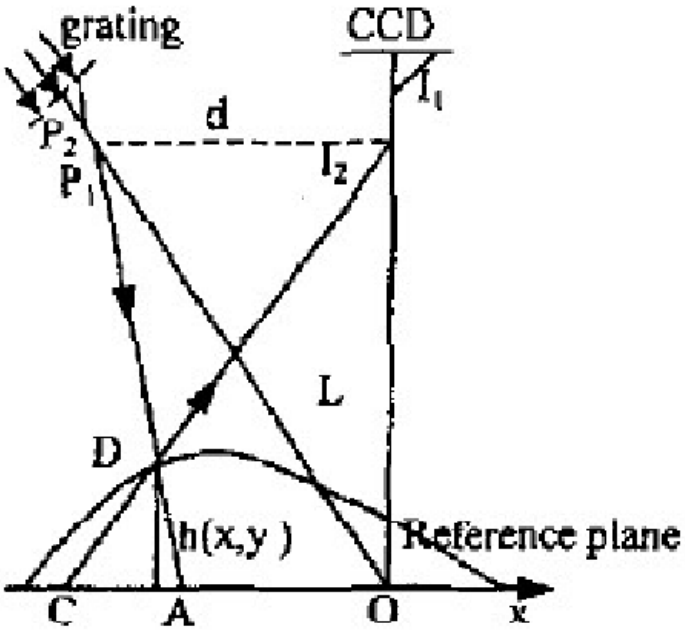
The structured light system (SLS) is always composed of a camera and a structured light projector.





Algorithm

The pattern modulated by the 3-D object.



$$\frac{h(x,y)}{L-h(x,y)}=\frac{CA}{d}$$

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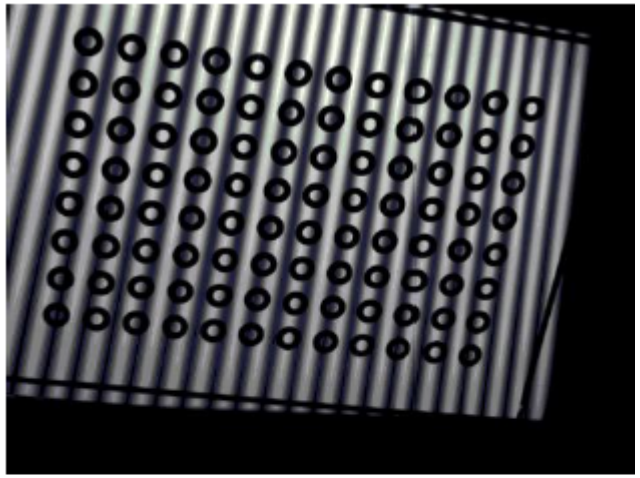
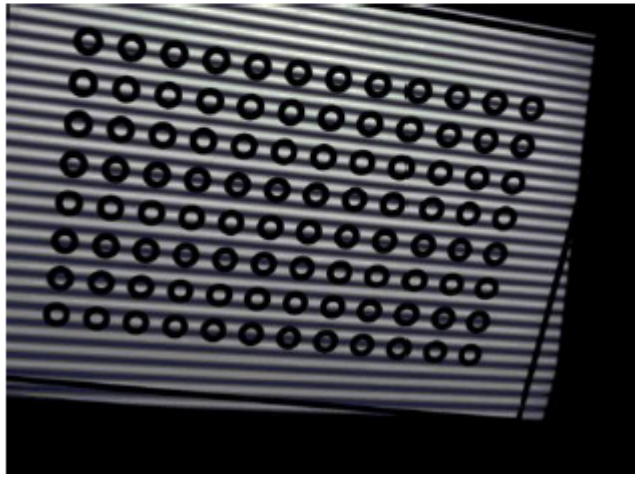
Algorithm

we need to calibrate the projector obtain the distance “d” between them.



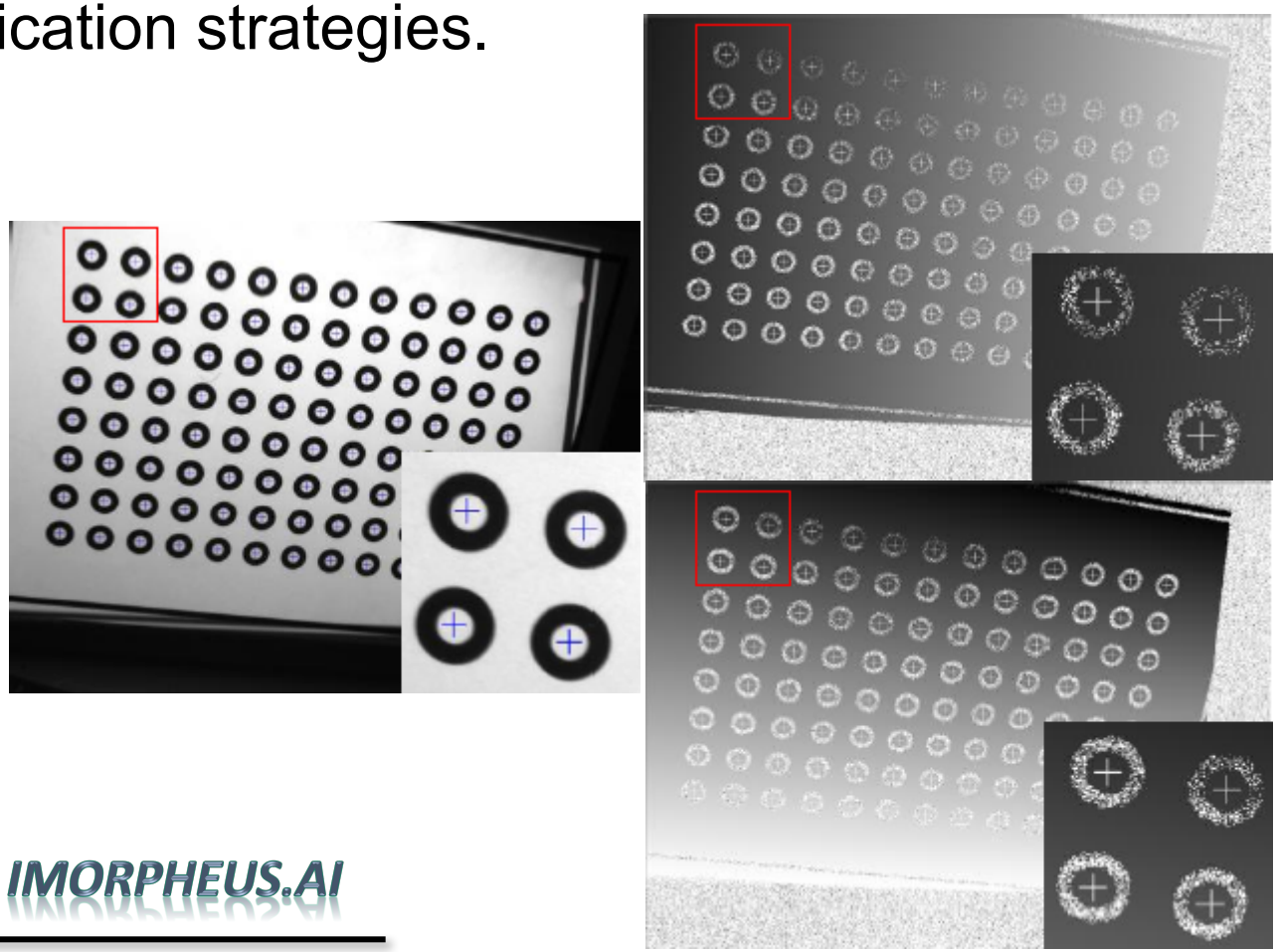
- The projector can not “see” images like a camera and is just able to project images.



- Use a calibrated camera to calibrate the projector.

Algorithm

- Determine the correspondence between the camera image and the projector image using the pattern codification strategies.



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Algorithm

$I(x)=R(x)[A(x)+B(x)\cos\varphi(x)]$

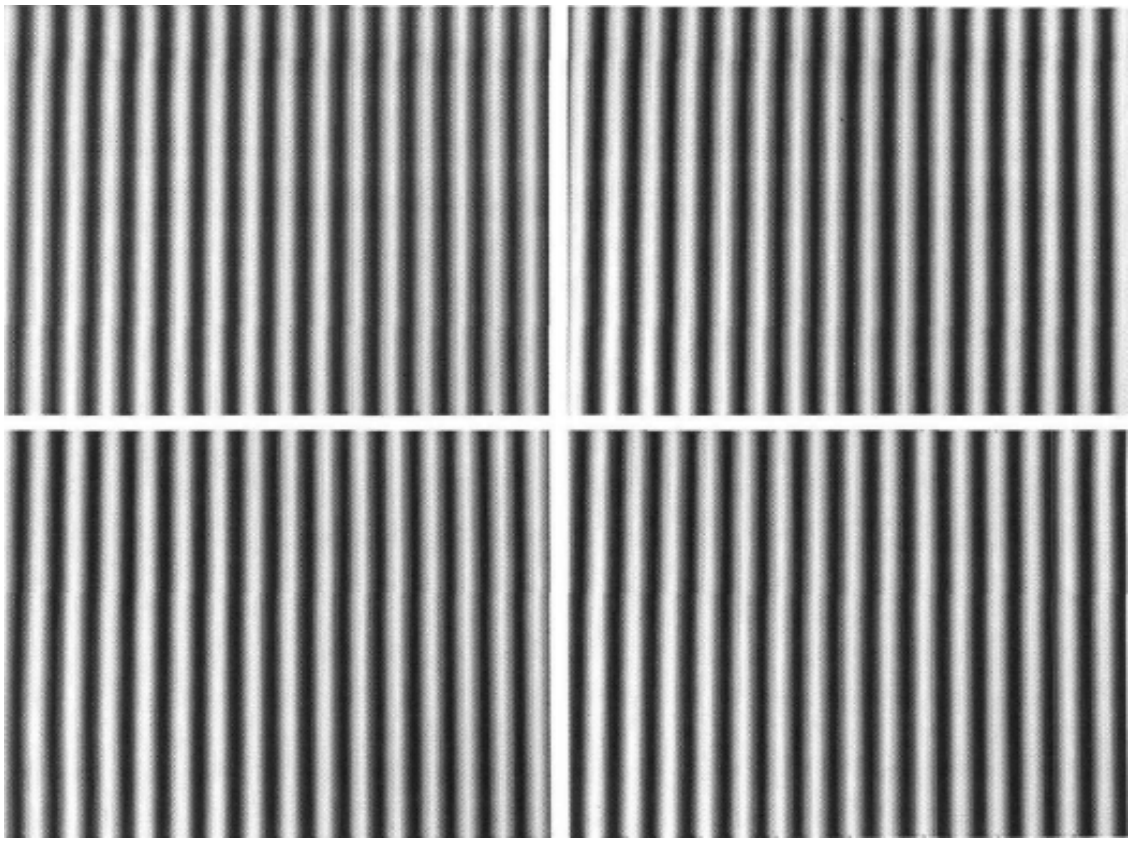
I(x): light value

R(x): reflectance

A(x): backgrond value

B(x)/A(x): contrast

φ(x): phase



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Algorithm

$$I(x)=R(x)[A(x)+B(x)\cos\varphi(x)]$$

$$I^P(x) = A^P + B^P \cos\left(\varphi^P(x) - \frac{2\pi n}{N}\right)$$

$$\varphi^P(x) = arctan\left[\frac{\sum_{n=0}^{N-1} I_n^P \sin\left(\frac{2\pi n}{N}\right)}{\sum_{n=0}^{N-1} I_n^P cos\left(\frac{2\pi n}{N}\right)}\right]$$

$$2\pi f x^P = 2k\pi + \varphi^P(x)$$

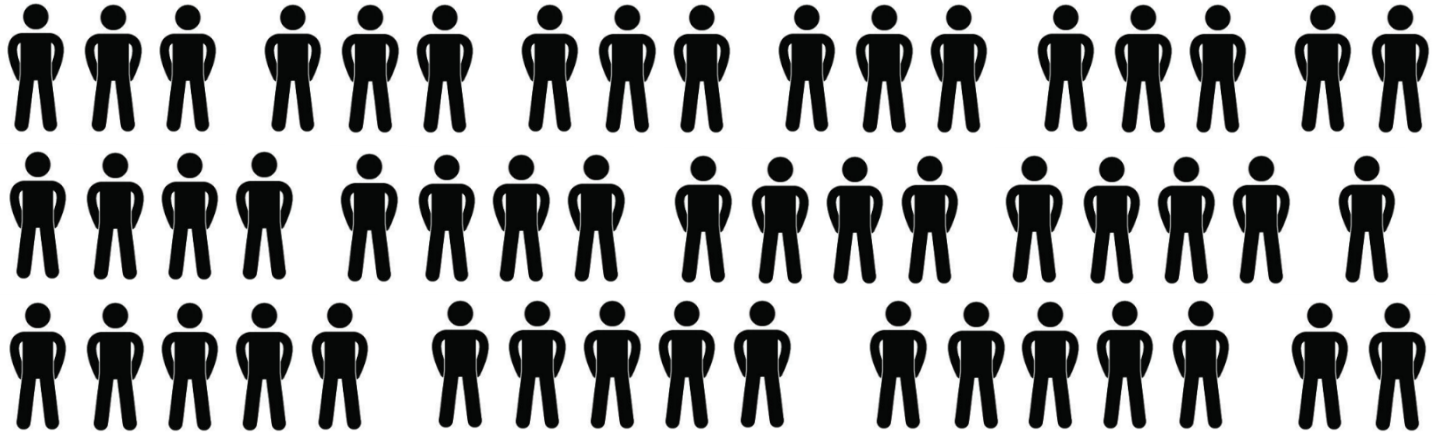
Algorithm

The problem has the same frame as the congruence problem.

$$2\pi f_i x^P = 2k_i\pi + \varphi_i^P(x)$$

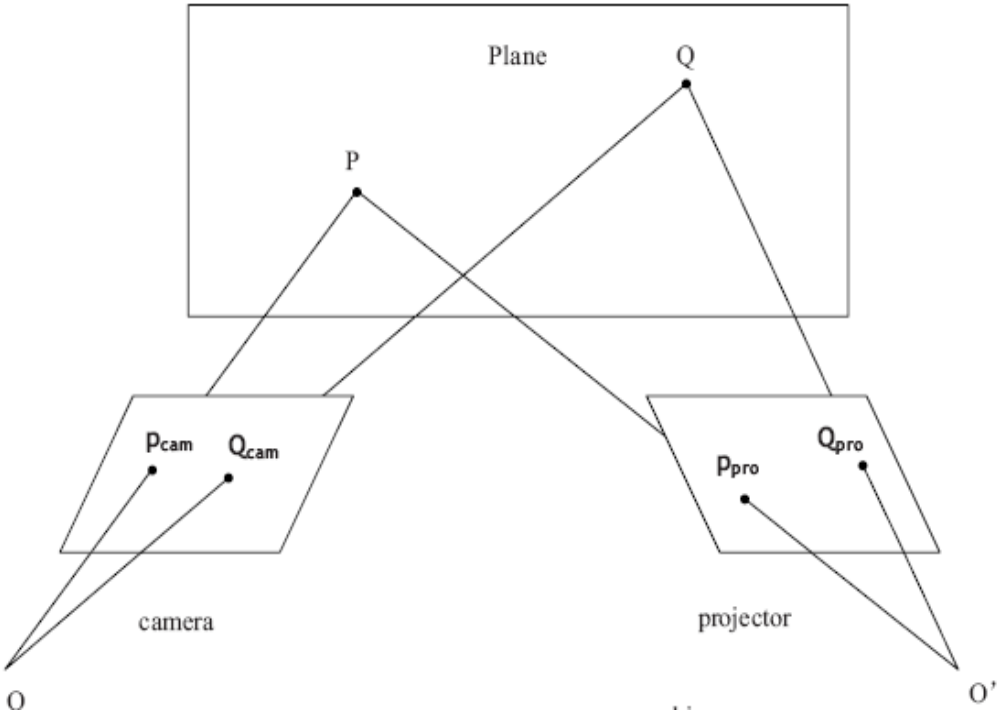
$$x^P = k_i\lambda_i + r_i$$

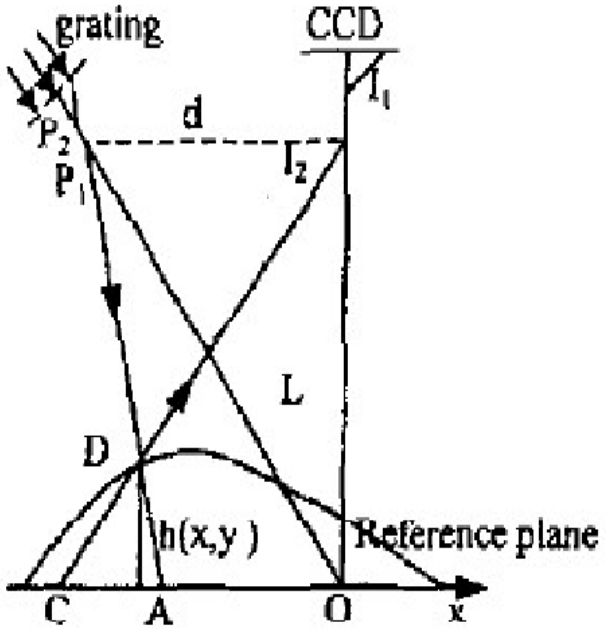
- Chinese remainder theorem



Algorithm

- Estimate the projector pose relative to the camera by the same feature points they “see”.





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Presentation and Evaluation

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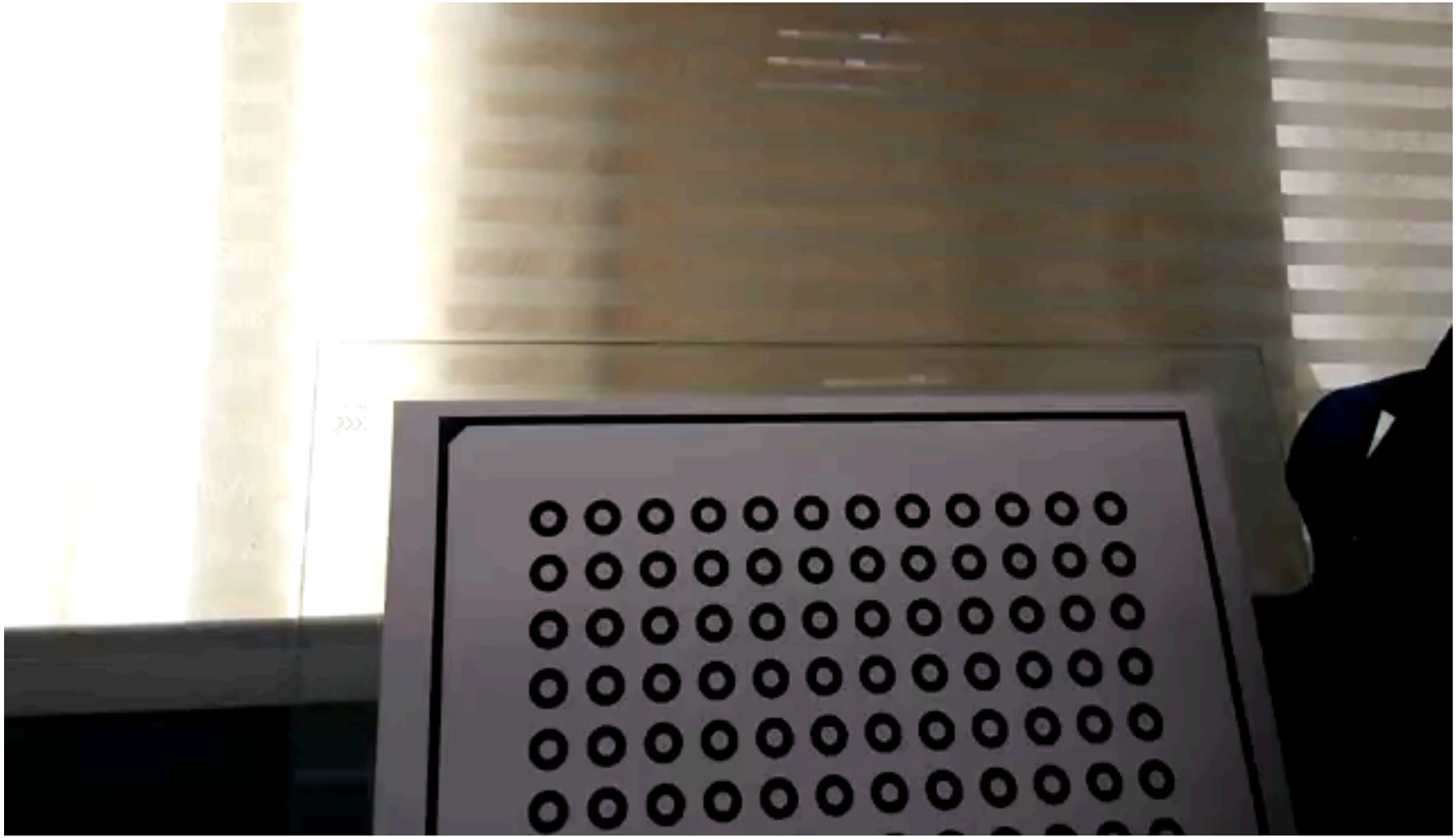
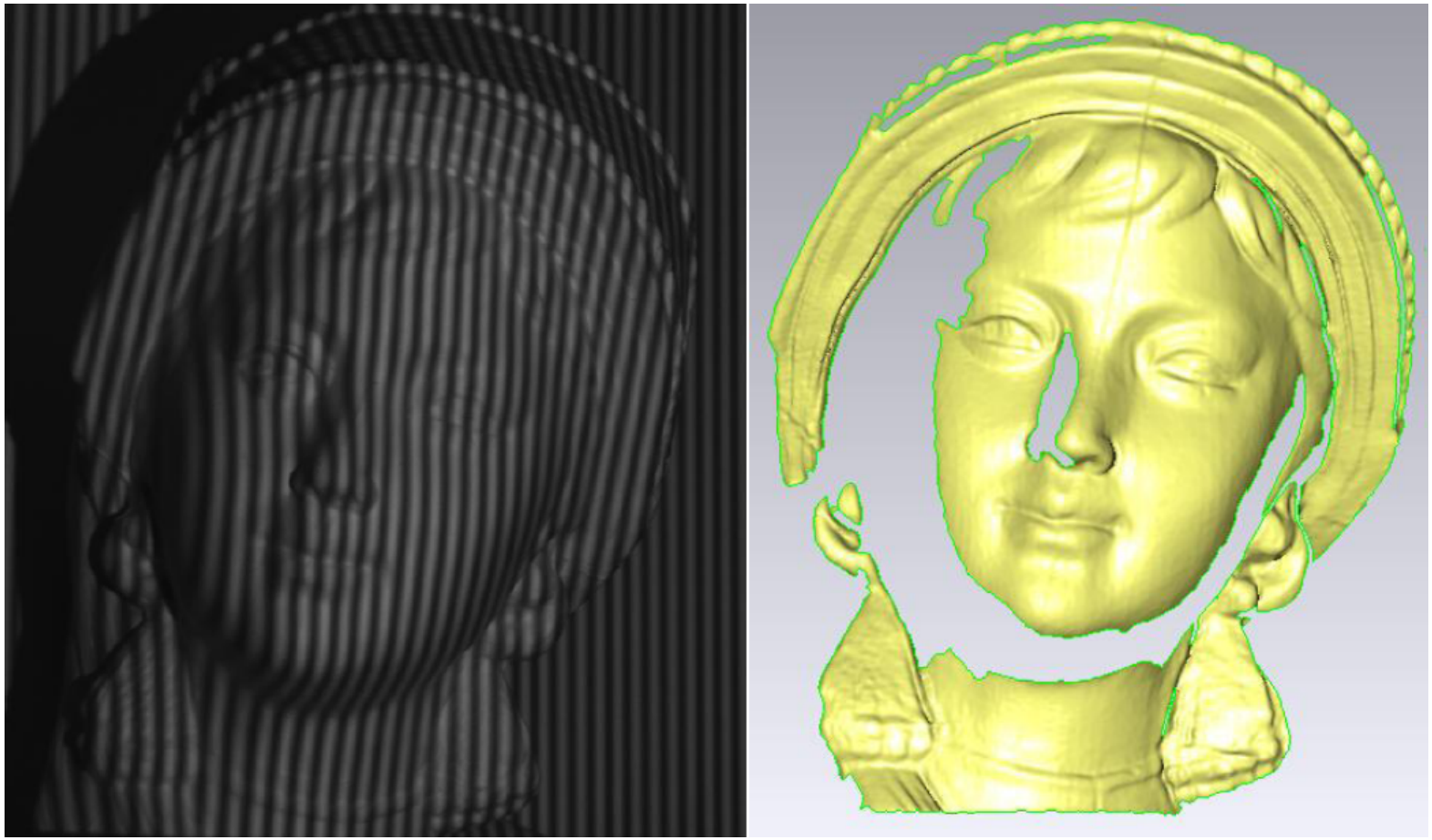


Presentation and Evaluation



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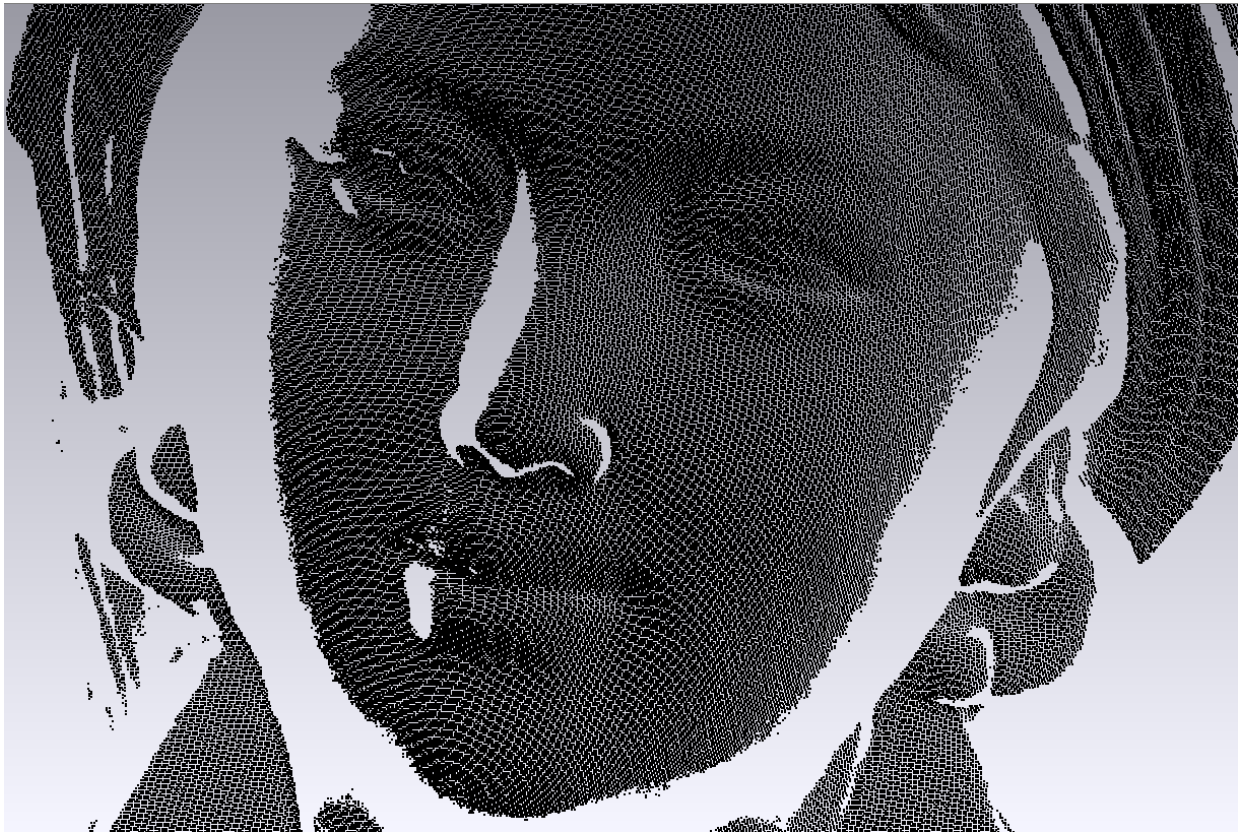
Presentation and Evaluation



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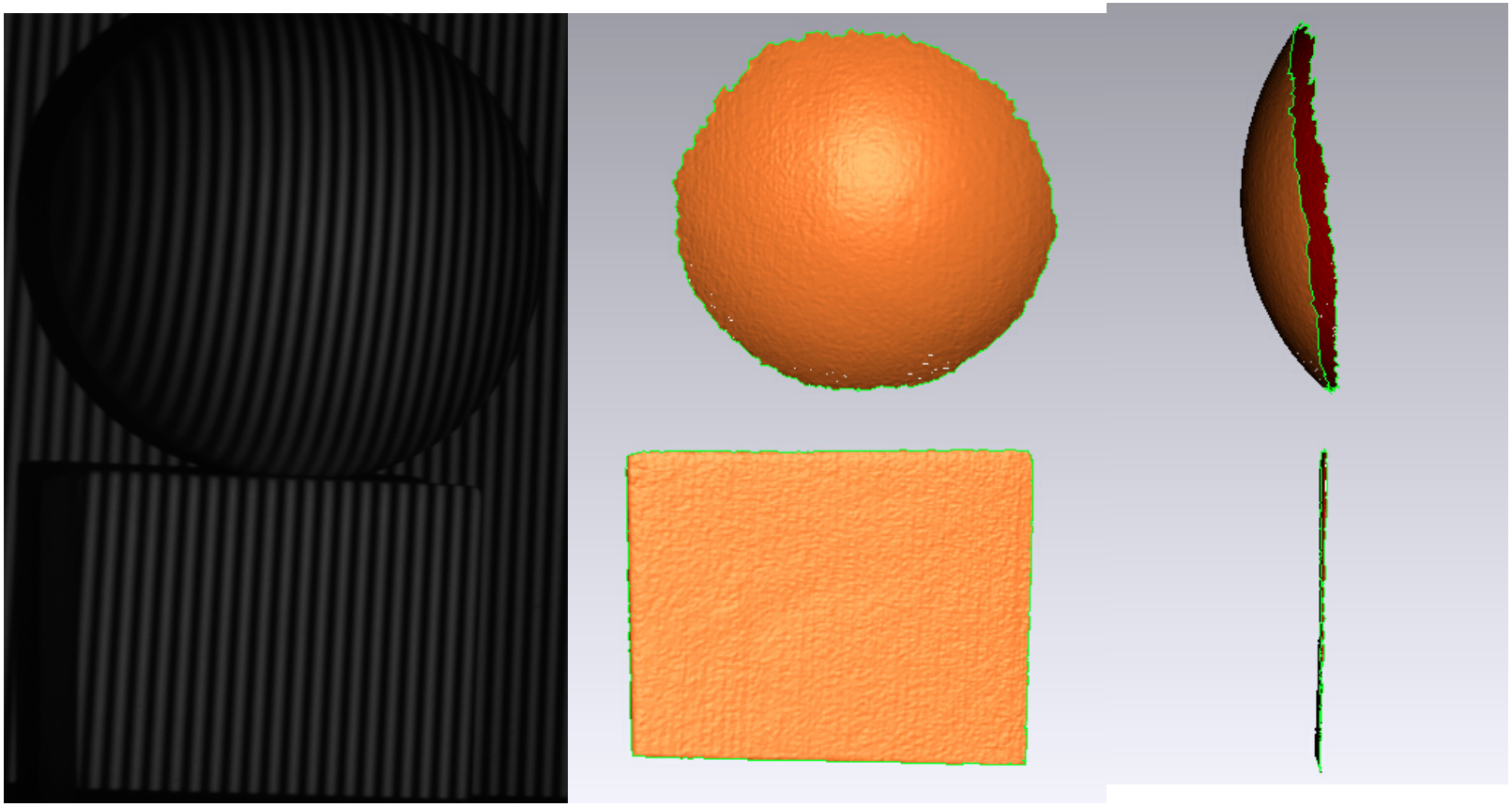
Presentation and Evaluation



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Presentation and Evaluation

Advantages:

- high accuracy
- dense data points

Disadvantages:

- vulnerable to light and material
- slower than traditional stereovision system

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References

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