



# IMAGE BASED RENDERING OF LARGE HISTORICAL IMAGE COLLECTION

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# OUTLINE

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05

RESEARCH APPROACH





# CONTEXT OF RESEARCH

VALORIZATION OF LARGE ICONOGRAPHIC COLLECTIONS

Advanced Linking and Exploitation of diGitized geOgRaphic  
Iconographic heritAge




Project ANR ALEGORIA n°ANR-17-CE38-0014-01 Images from "Archives nationales/Fonds LAPIE"





# CONTEXT OF RESEARCH

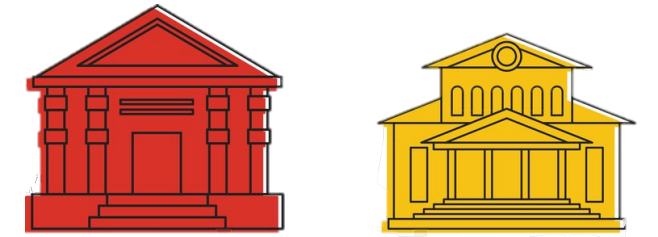
## DATASET

Institution	Collection	Type	Context	Point of View	Date	No. Images	Example
National Archives	Carto MRU	image	topographical	oblique	1948-1970	13562	
	Lapie		commercial		1955-1965	29140	
Niéphore Niépce Museum	Combiér	image	postcards	randomly	1949-1974	10000	
	Bouquet		army	vertical	1914-1918	49	
	Bron		aerial	vertical and oblique	1924-1926	130	
	Falba			vertical	1951-1960	550	
	Henrad			oblique	1930-1970	1100	
	Franjus				1960-1990	877	
IGN	Stereopolis	image + lidar (pointcloud)	mobile mapping	terrestrial, panoramic and stereo	2007-2016	8280000	
	BD TOPO	geometry	3D vectorial description	vertical	1998-2005	-	

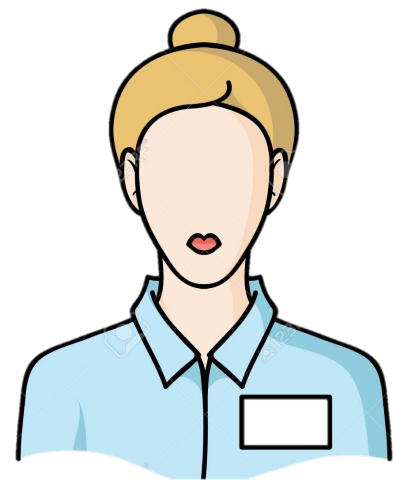
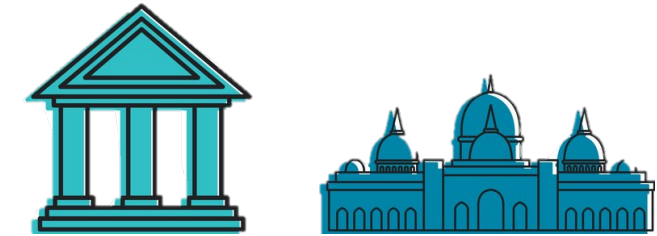
# CONTEXT OF RESEARCH

SYSTEM

GLAM

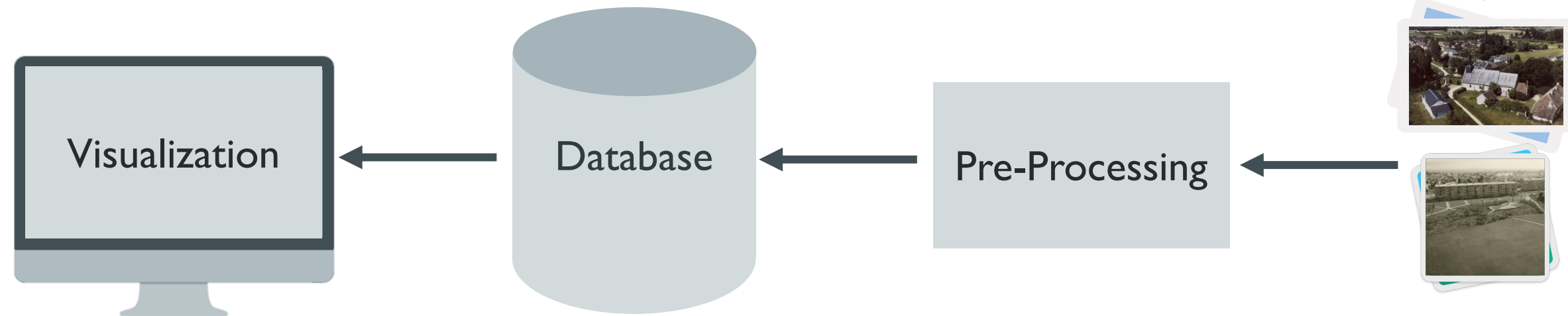


Galleries, Libraries,  
Archives and Museums



User

Archivists, Historians and  
Researchers in Humanities



Dataset

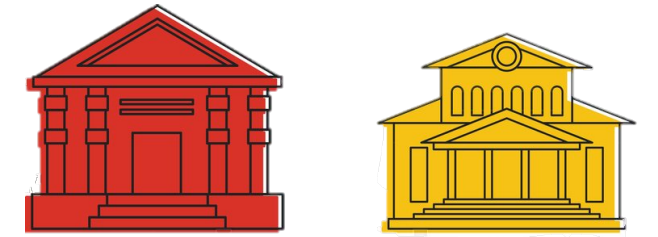
Street Level and Aerial Photographs,  
Lidiar Data, etc.



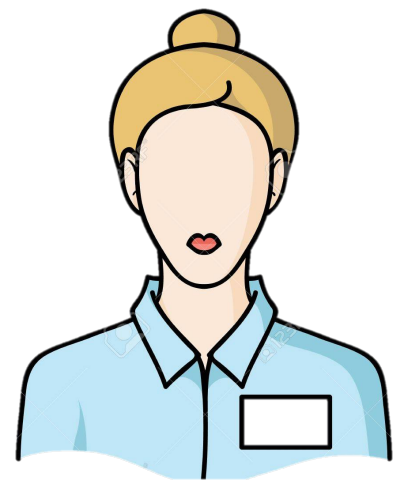
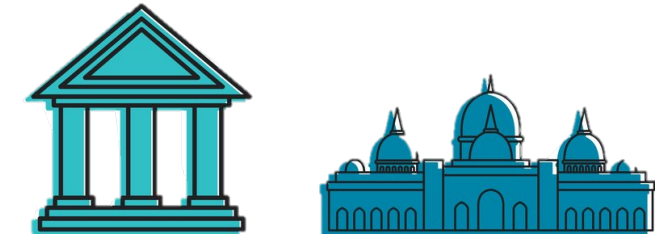
# CONTEXT OF RESEARCH

SYSTEM

GLAM

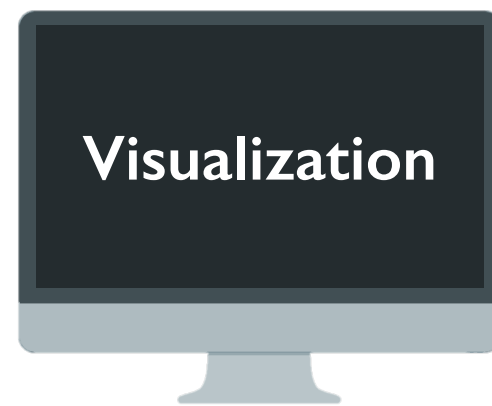


Galleries, Libraries,  
Archives and Museums



User

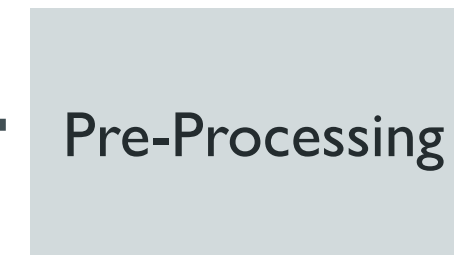
Archivists, Historians and  
Researchers in Humanities



Visualization



Database



Pre-Processing

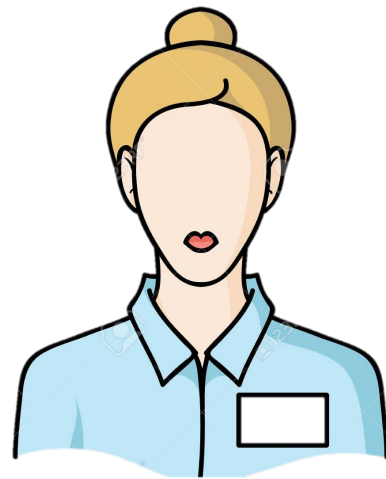


Dataset

Street Level and Aerial Photographs,  
Lidiar Data, etc.

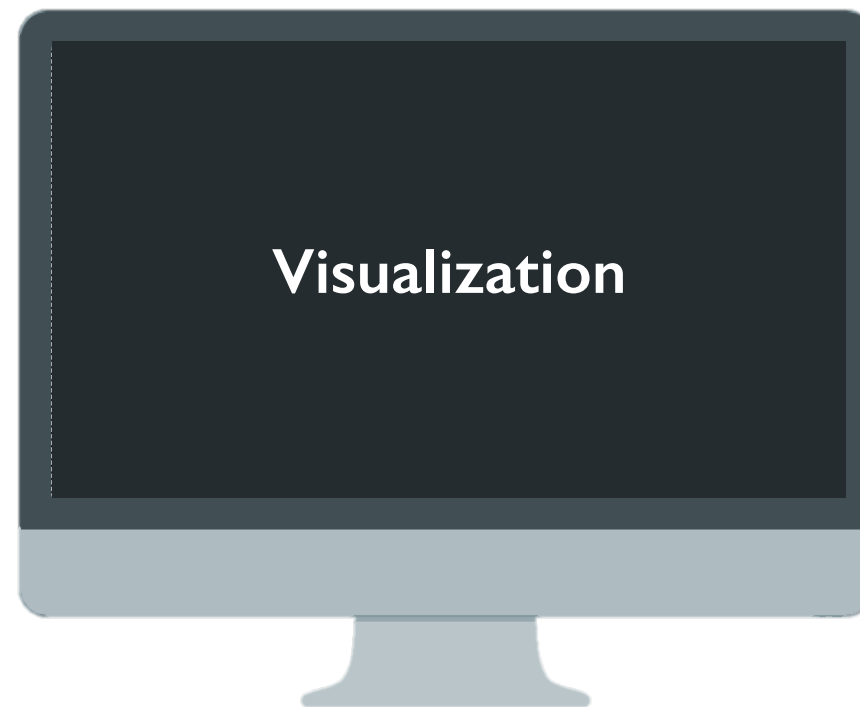
# INTRODUCTION

## EXISTING TOOLS



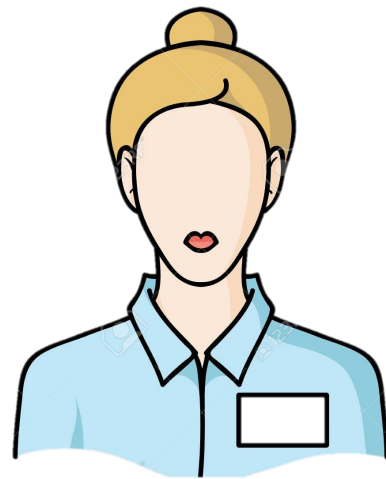
User

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Researchers in Humanities



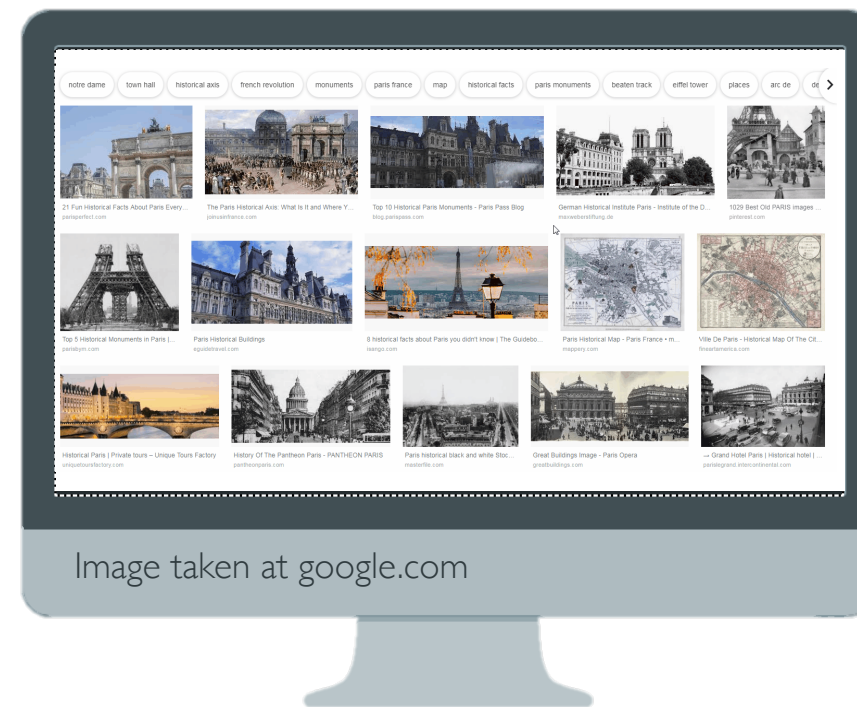
# INTRODUCTION

## EXISTING TOOLS - PHOTO LIBRARY



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Researchers in Humanities





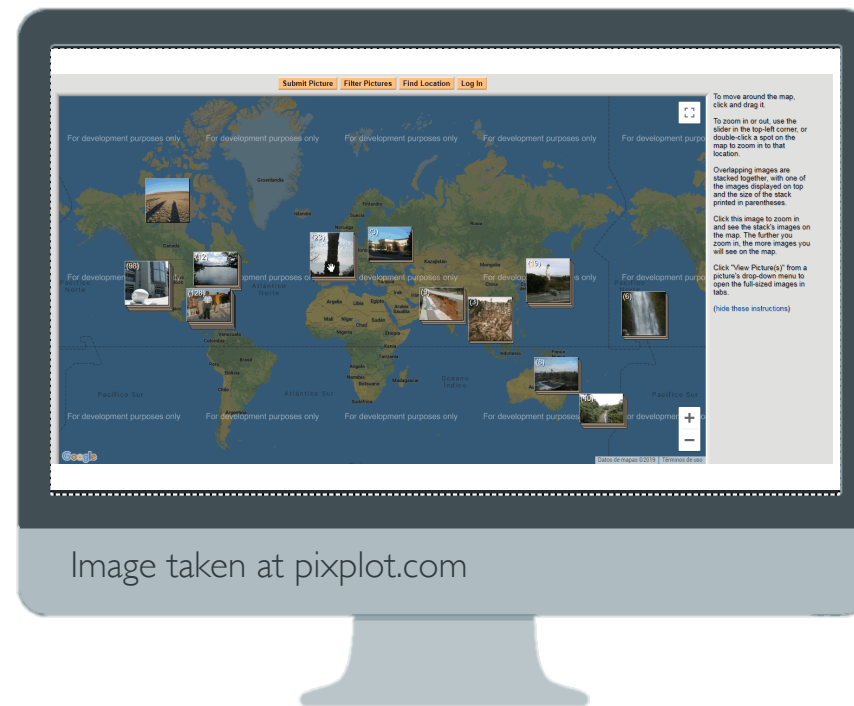
# INTRODUCTION

## EXISTING TOOLS - PIXPLOT



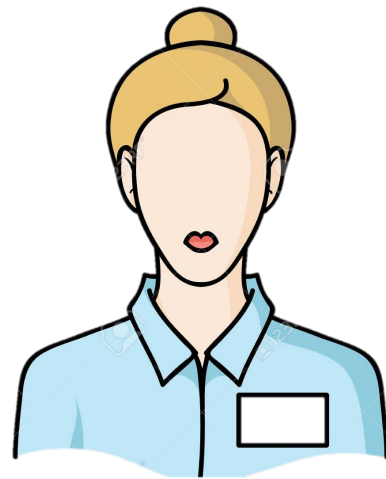
User

Archivists, Historians and  
Researchers in Humanities



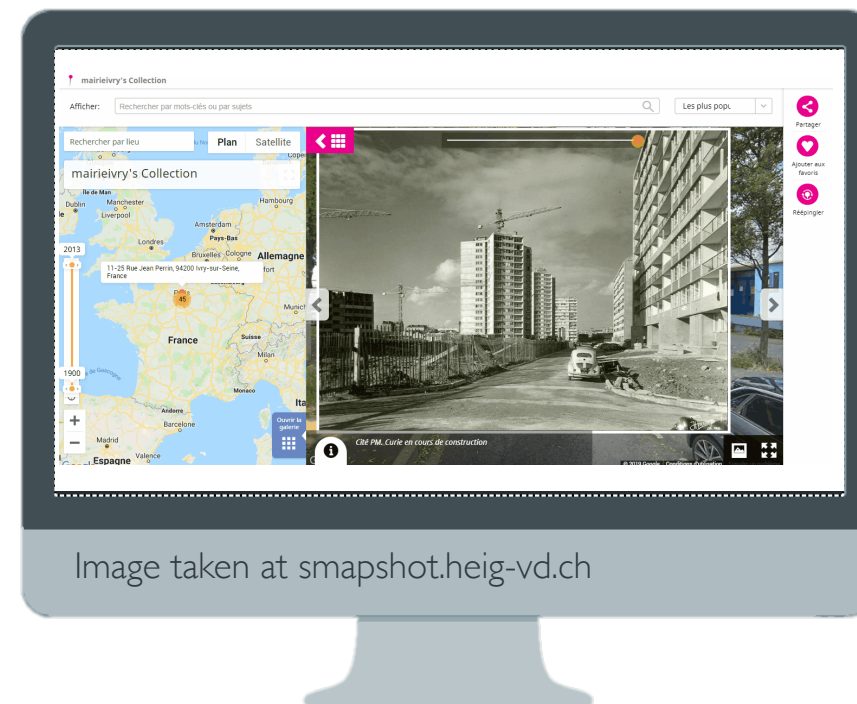
# INTRODUCTION

## EXISTING TOOLS - HISTORYPIN



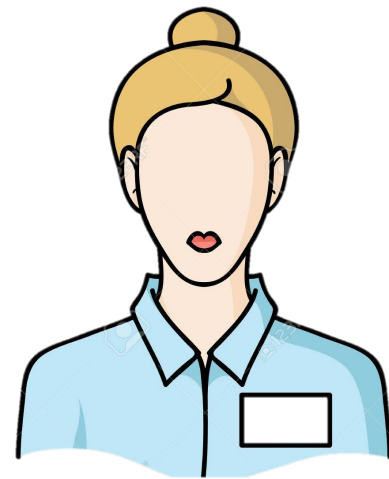
User

Archivists, Historians and  
Researchers in Humanities



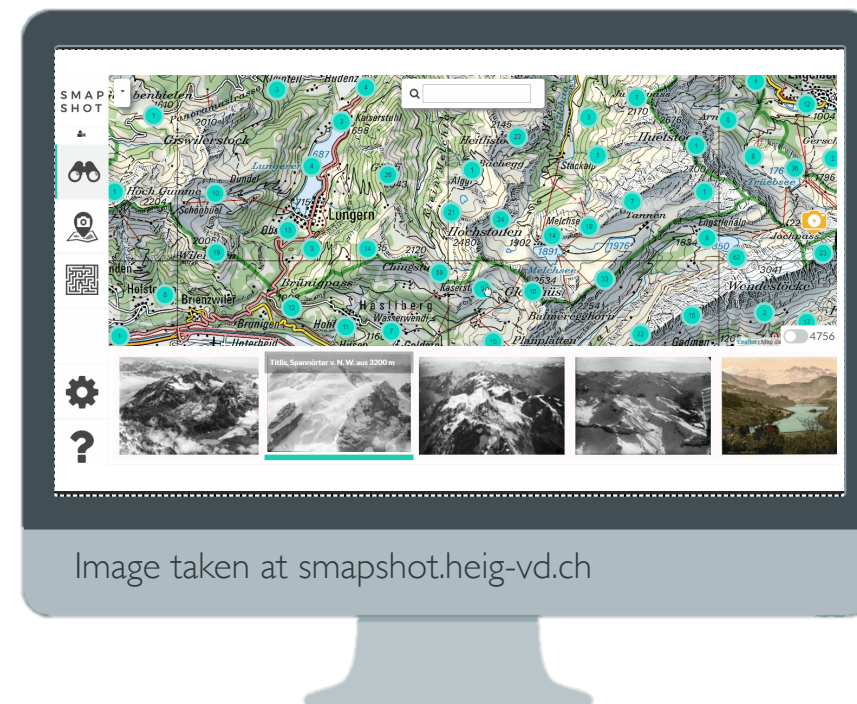
# INTRODUCTION

## EXISTING TOOLS - SMAPSHOT



User

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Researchers in Humanities



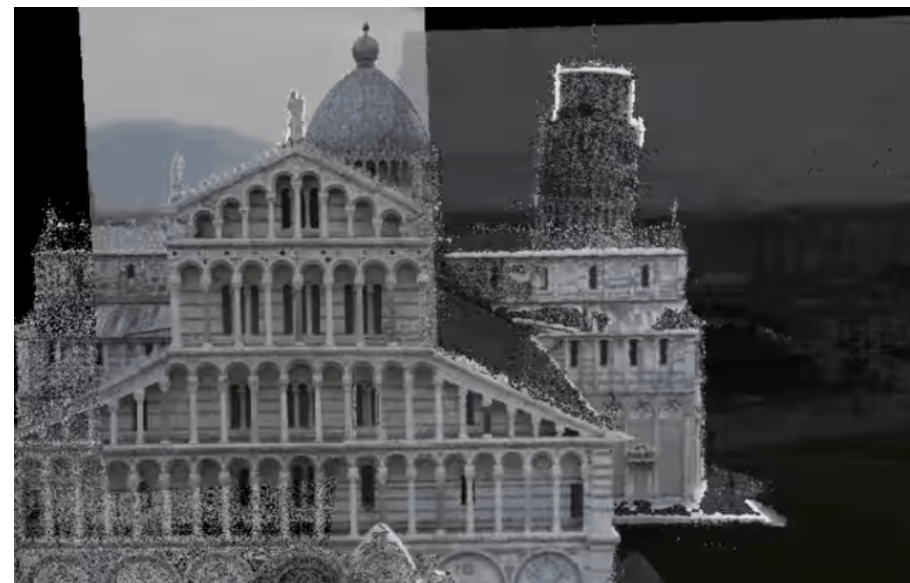


# INTRODUCTION

## RELATED WORK



SNAVELY N., et. al.: Photo Tourism: exploring photo collections in 3D, ACM SIGGRAPH, 2006.



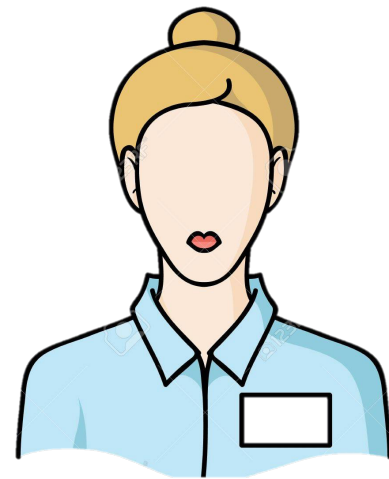
GOESELE M., et. al.: Ambient point clouds for view interpolation, ACM Trans. Graph 29, 2010.



BRIVIO P., et. al.: PhotoCloud: Interactive remote exploration of joint 2D and 3D datasets, IEEE Transactions on Visualization and Computer Graphics 23, 2017.

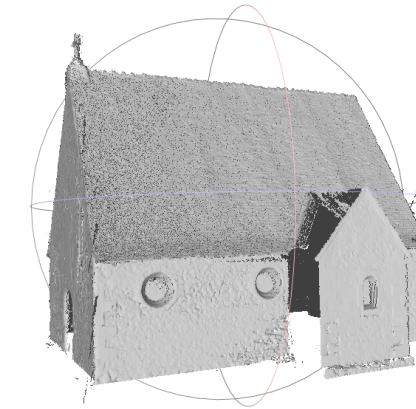
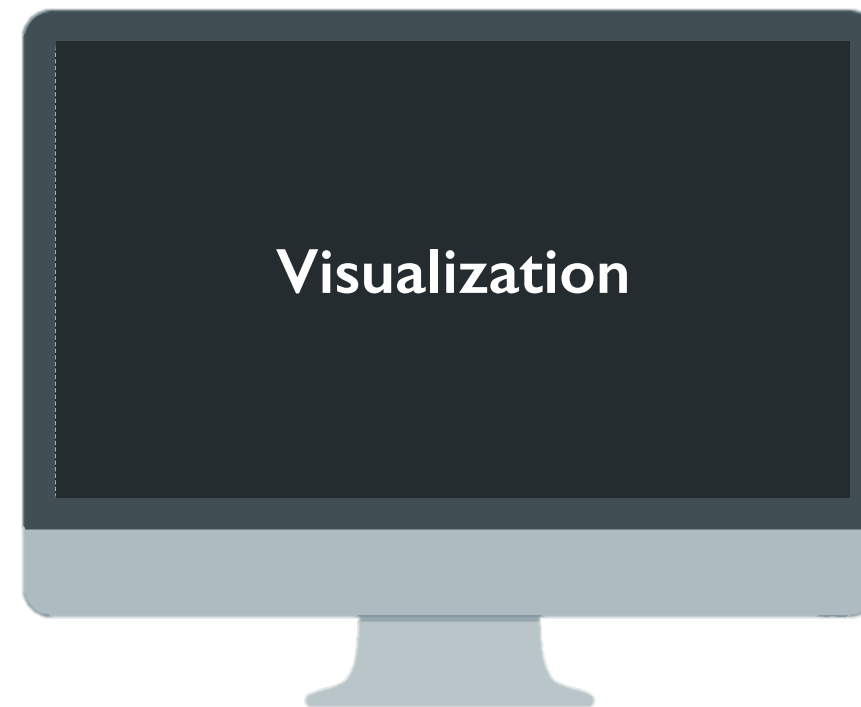
# INTRODUCTION

## RENDERING



User

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Researchers in Humanities



3D  
Geometry

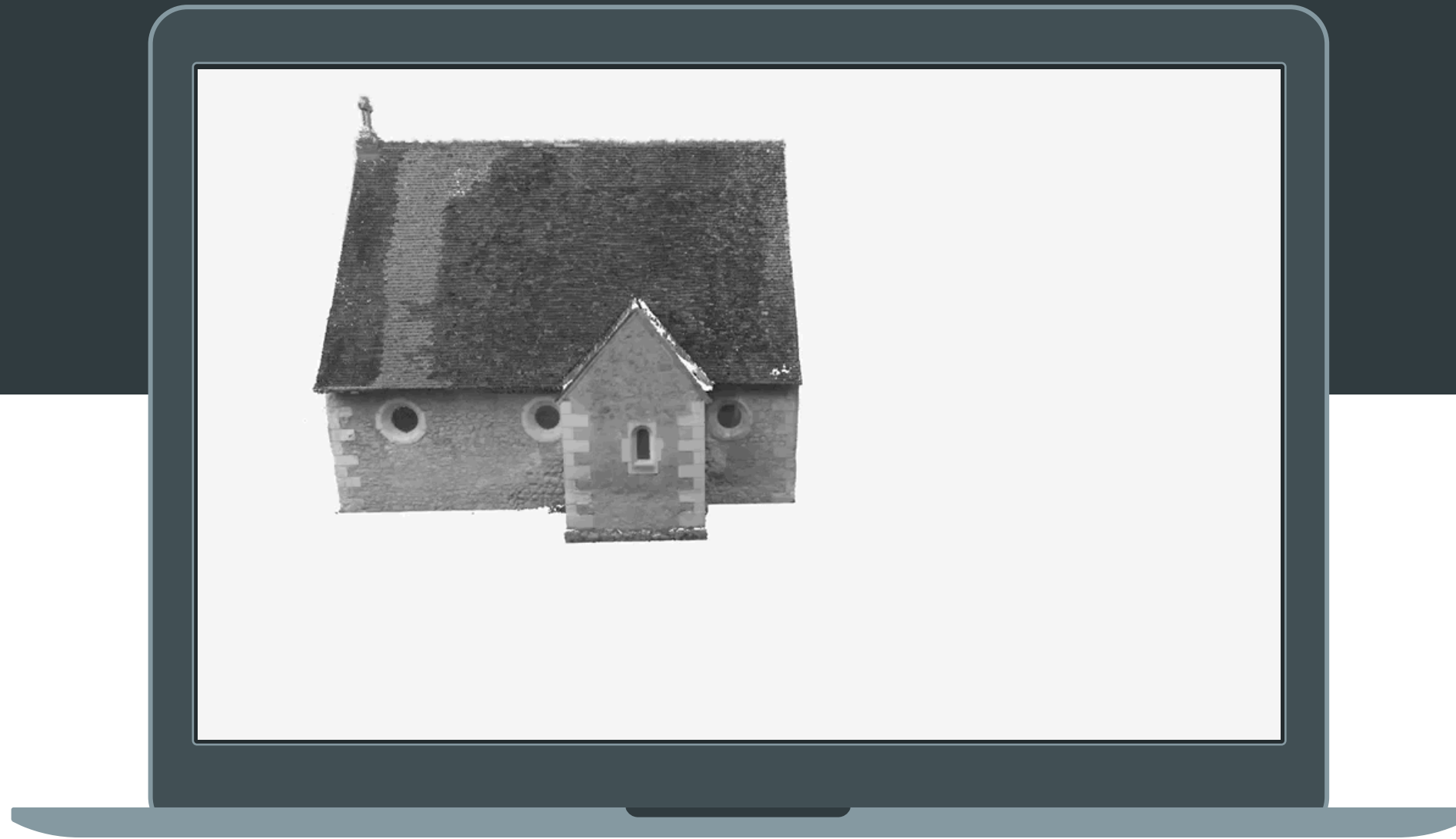


Historical  
Photograph



Orientation  
Data

# INTRODUCTION



## CAMERA DEFINITION



Pinhole Camera Model

**View Camera**



# INTRODUCTION

## CAMERA DEFINITION



Pinhole Camera Model

**View Camera**

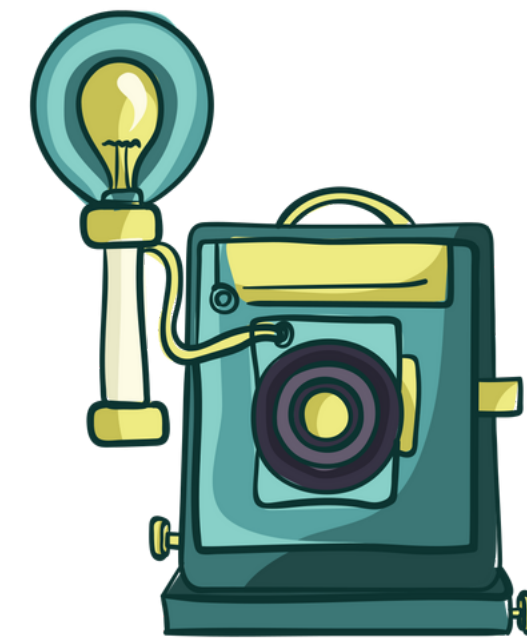
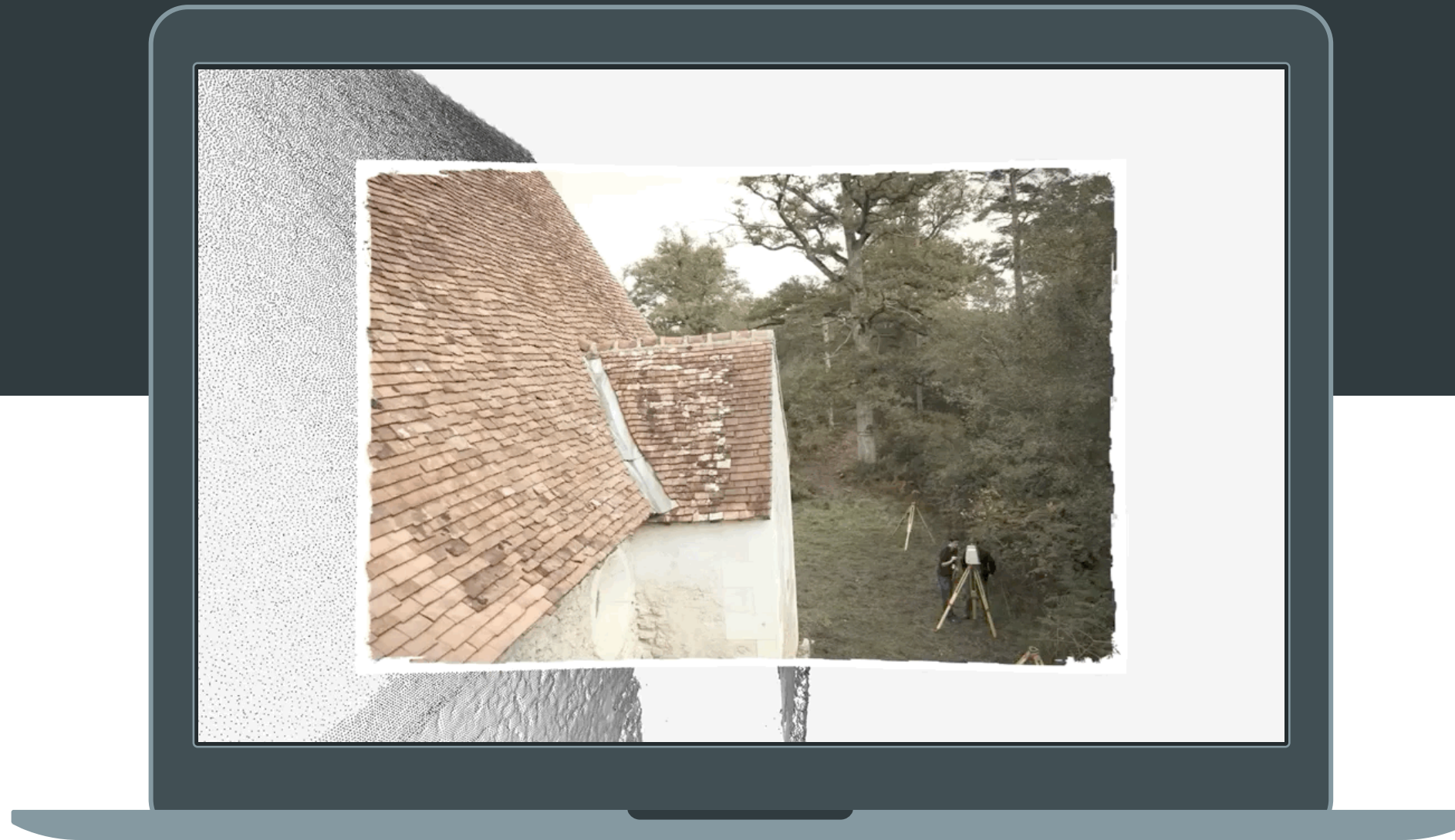
**Historical Camera**

Distorted Camera  
Model



# INTRODUCTION

## PROJECTIVE TEXTURING



Pinhole Camera Model

**View Camera**



**Historical Camera**

Distorted Camera Model



# PROBLEM STATEMENT

Leave the images untouched but still make them fit the 3D surrounding?

## ARTIFACT CORRECTION

Avoid artifacts and misalignments between photographs and the scene?

DISTORTION

01

02

UNCERTAINTY

NAVIGATION

04

03

RADIOMETRY

Explore a massive image collections?

## GRAPHIC REPRESENTATION

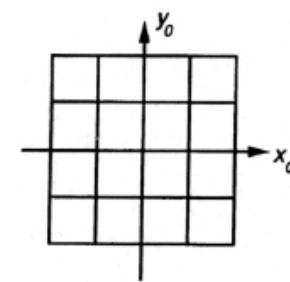
Adapt the color contrast between the images and their 3D environment?

# PROBLEM STATEMENT

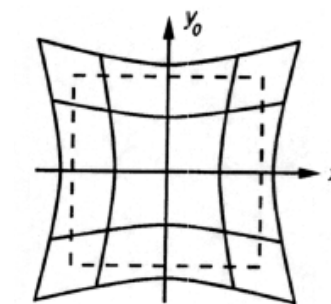


01

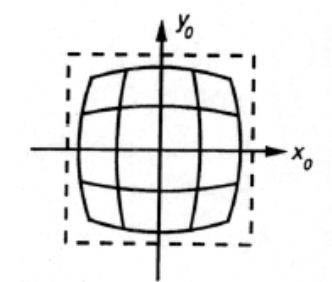
DISTORTION



No Distortion



Pincushion



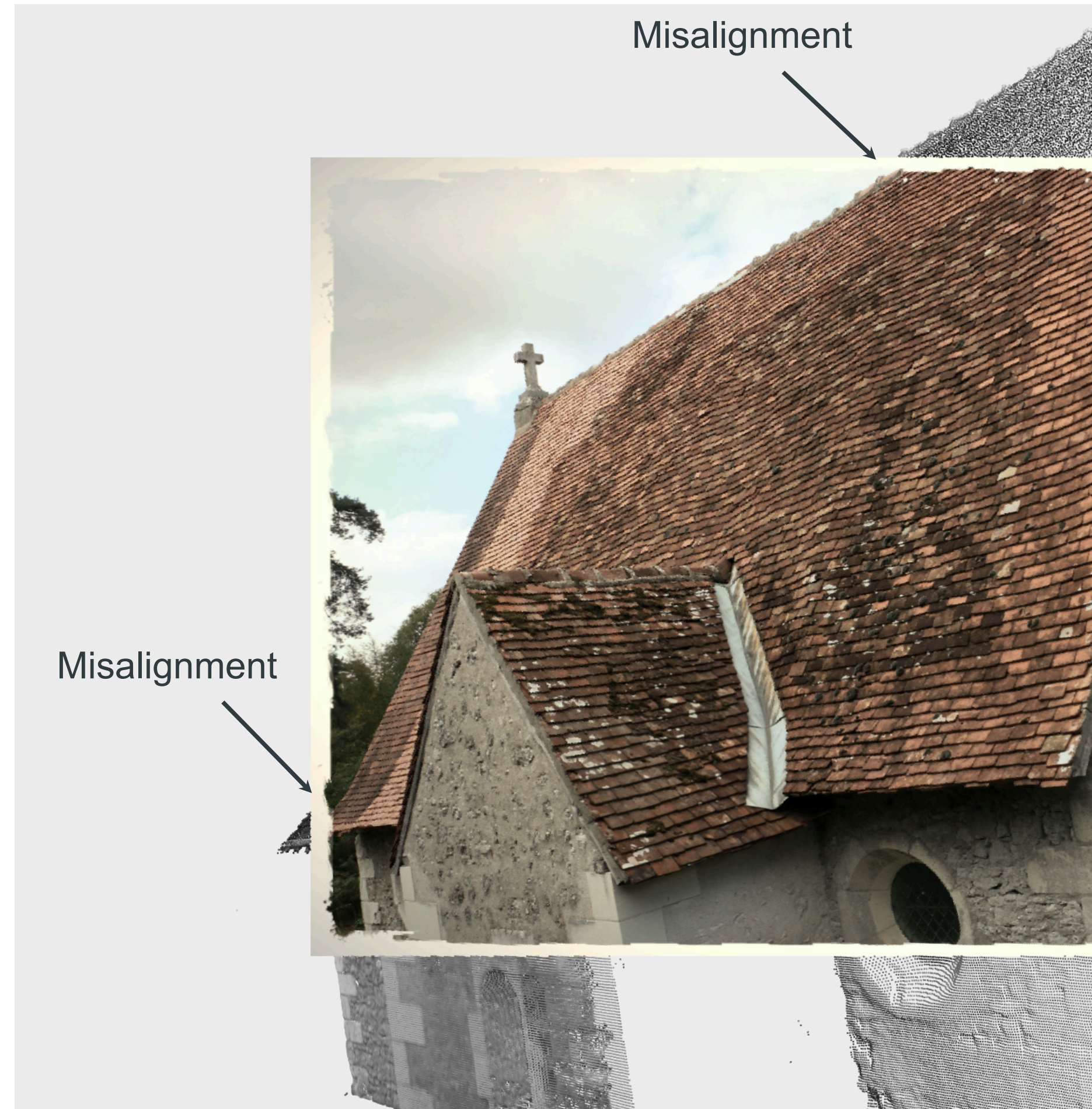
Barrel



# PROBLEM STATEMENT

02

UNCERTAINTY







03

RADIOMETRY

# PROBLEM STATEMENT



# PROBLEM STATEMENT

NAVIGATION

04



Mock-up using:  
BRIVIO P., et. al.: PhotoCloud: Interactive remote exploration of joint 2D and 3D datasets, IEEE Transactions on Visualization and Computer Graphics 23, 2017.



Itowns and BD TOPO © IGN 2019

HARRACH M., DEVAUX A., BREDIF M.: Interactive image geolocalization in an immersive web application, 3D-Arch, 2018.



# RESEARCH OBJECTIVE

Continuous immersive visualization and navigation through time and space of large sets of historical photographs in a present day geographic 3D scene.

# RESEARCH APPROACH

Leave the images untouched but still make them fit the 3D surrounding?

## ARTIFACT CORRECTION

Avoid artifacts and misalignments between photographs and the scene?

DISTORTION

01

02

UNCERTAINTY

NAVIGATION

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03

RADIOMETRY

Explore a massive image collections?

## GRAPHIC REPRESENTATION

Adapt the color contrast between the images and their 3D environment?

# RESEARCH APPROACH

Leave the images untouched but still make them fit the 3D surrounding?

## ARTIFACT CORRECTION

Avoid artifacts and misalignments between photographs and the scene?

DISTORTION

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RADIOMETRY

Explore a massive image collections?

## GRAPHIC REPRESENTATION

Adapt the color contrast between the images and their 3D environment?



# DISTORTION

## INTRODUCTION

### VISUALIZATION OF A SINGLE IMAGE



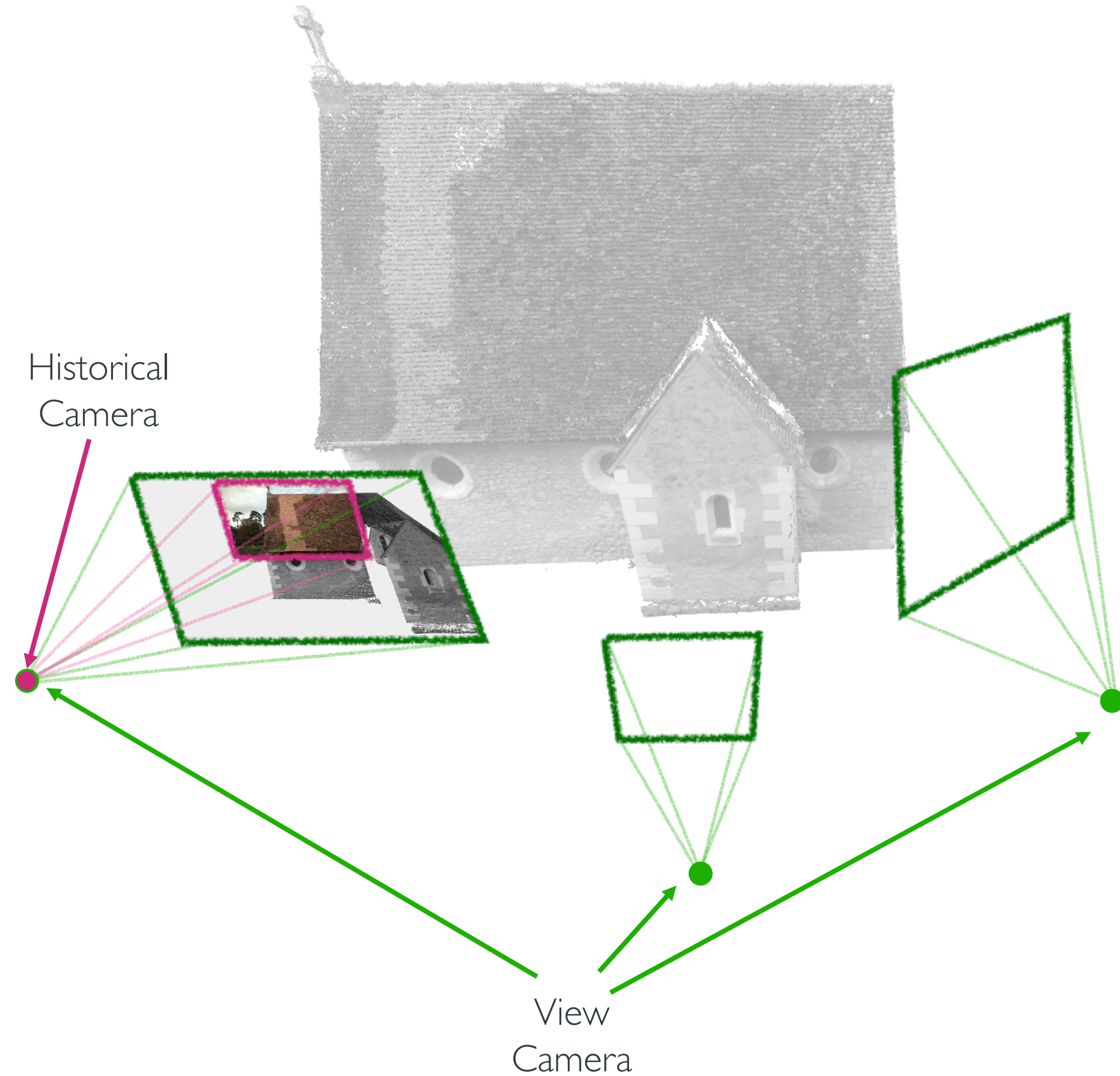
Pinhole Camera Model

View Camera

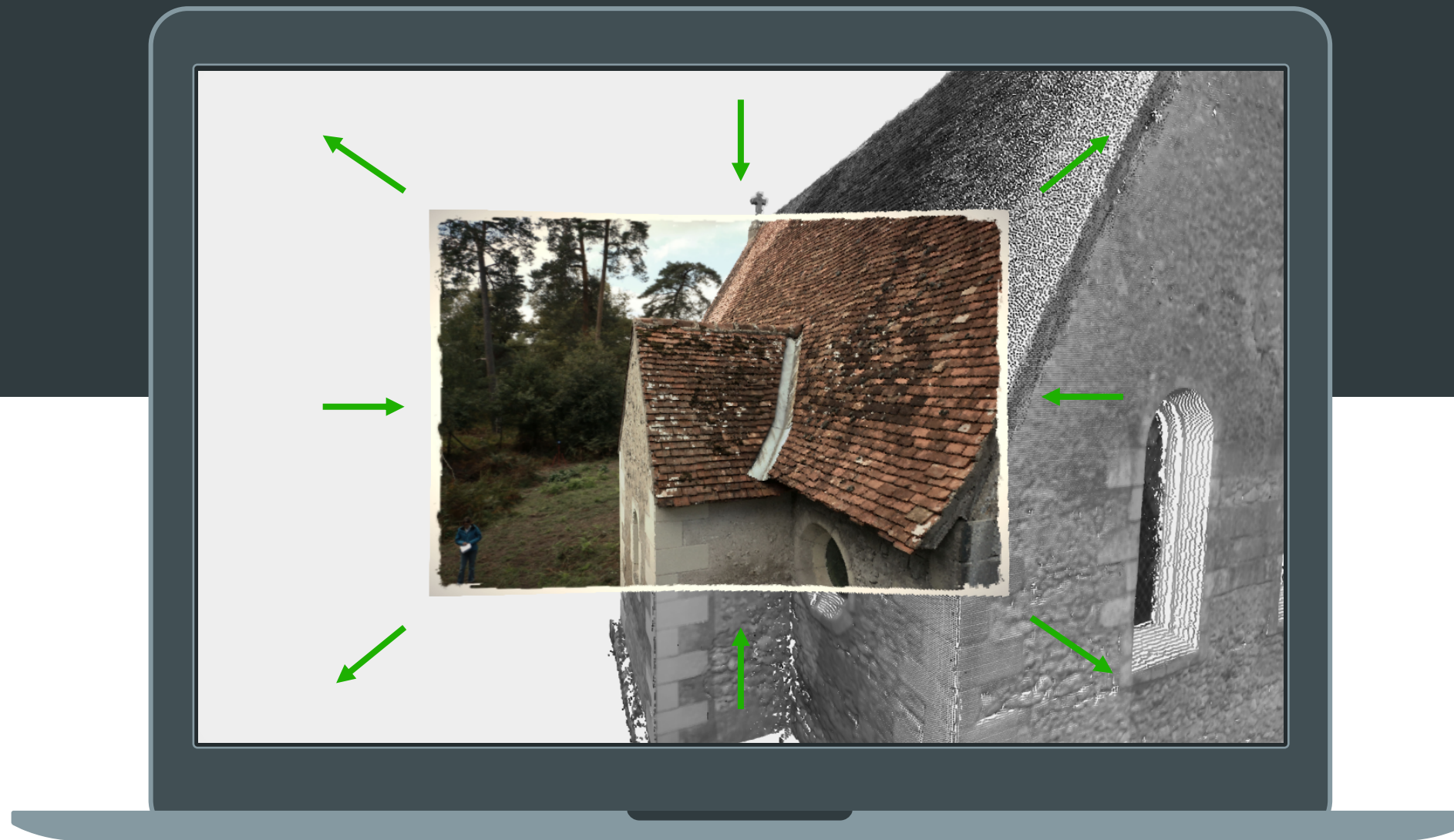


Historical Camera

Distorted Camera Model



# DISTORTION INTRODUCTION



## DISTORTION

A small change in our coordinates.  
(i.e. related in this case to our optical lens).



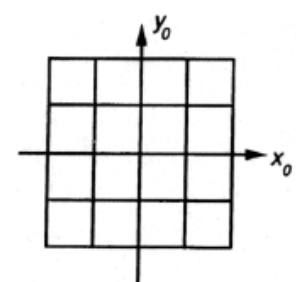
Pinhole Camera Model

**View Camera**

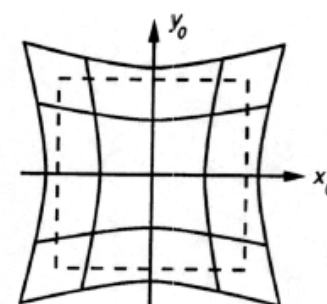


**Historical Camera**

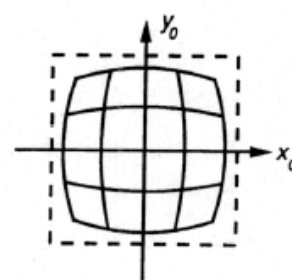
Distorted Camera Model



No Distortion



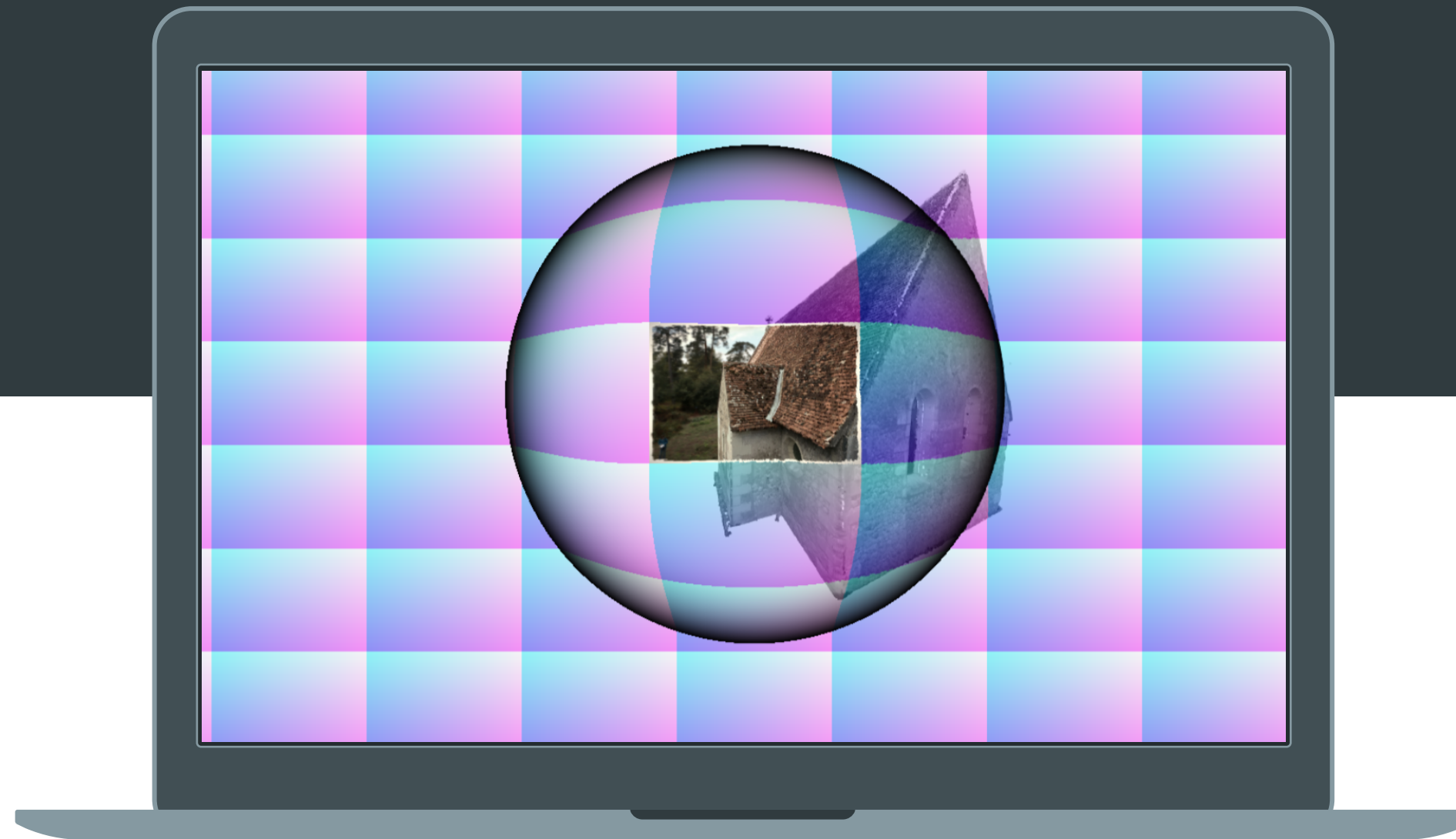
Pincushion



Barrel

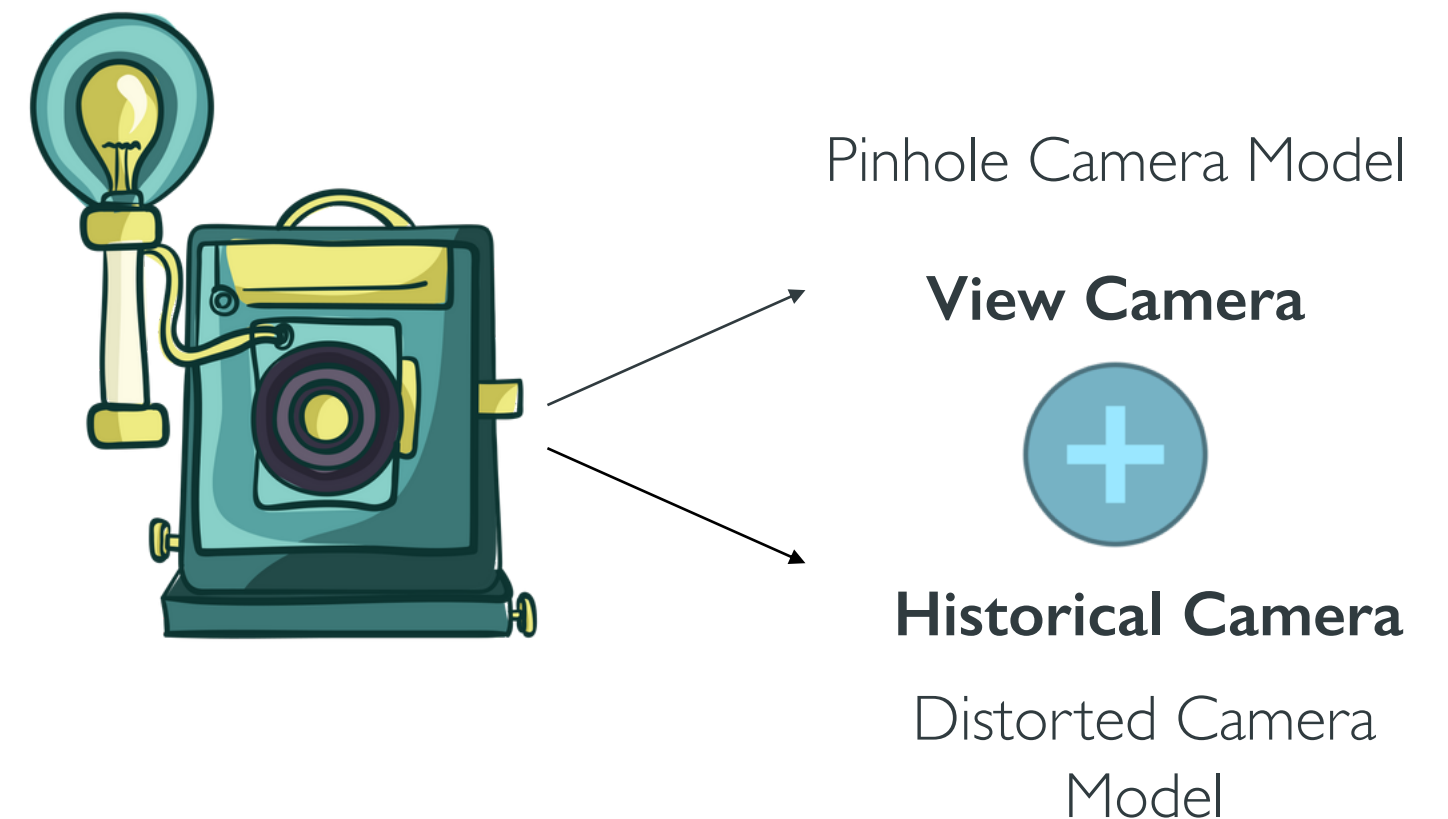


# DISTORTION INTRODUCTION

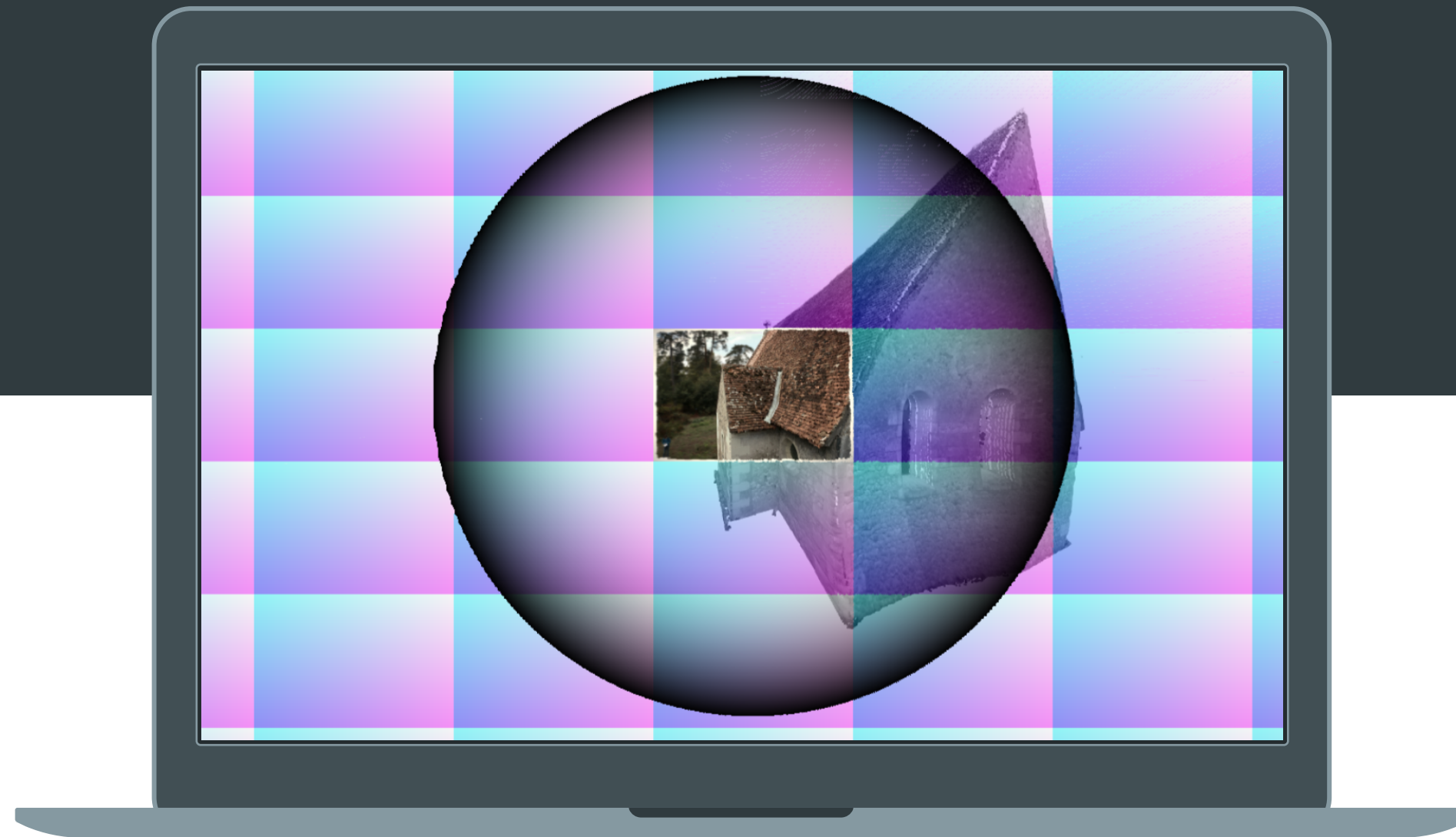


## DISTORTION

A small change in our coordinates.  
(i.e. related in this case to our optical lens).

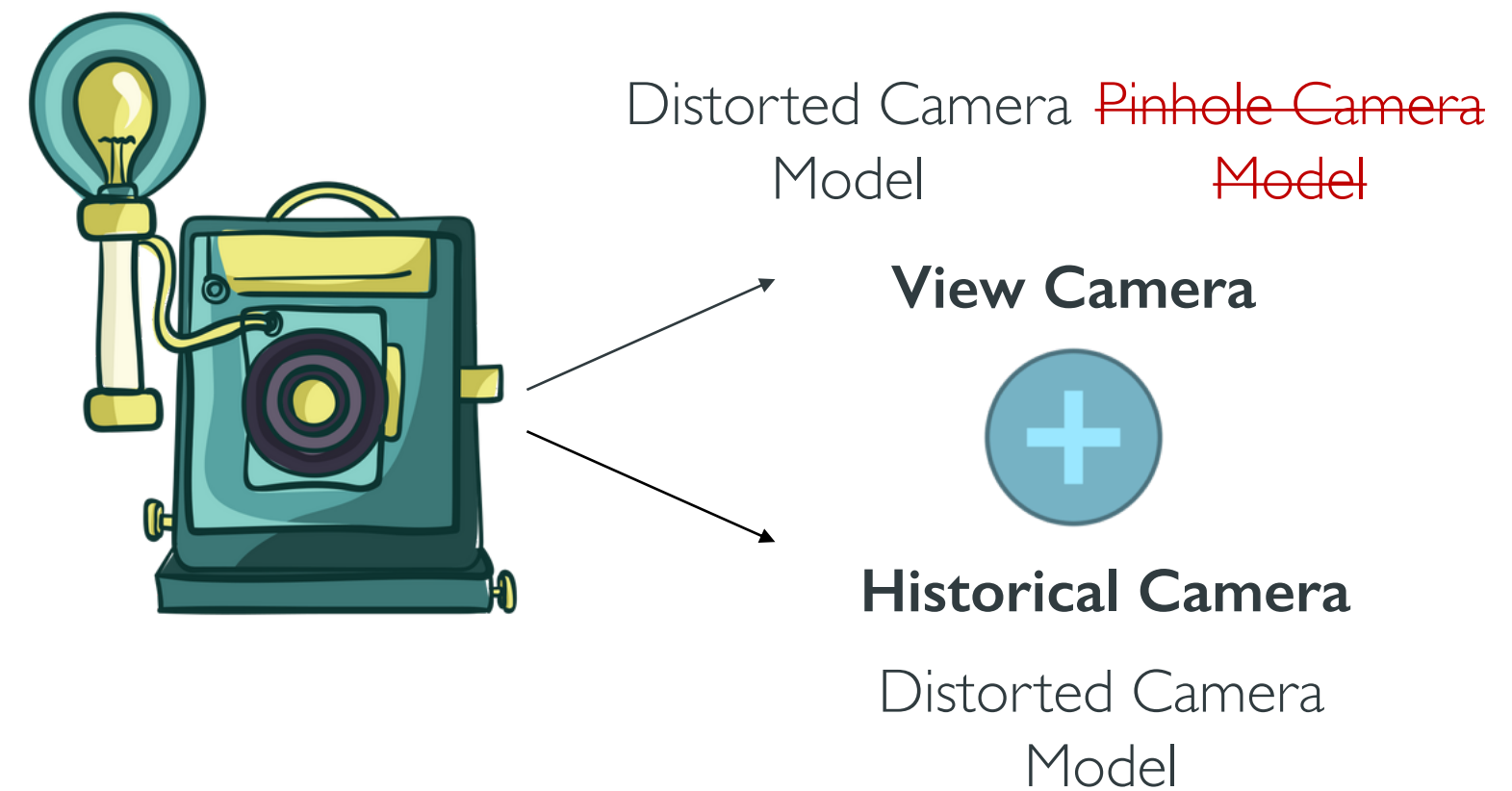


# DISTORTION INTRODUCTION



## DISTORTION

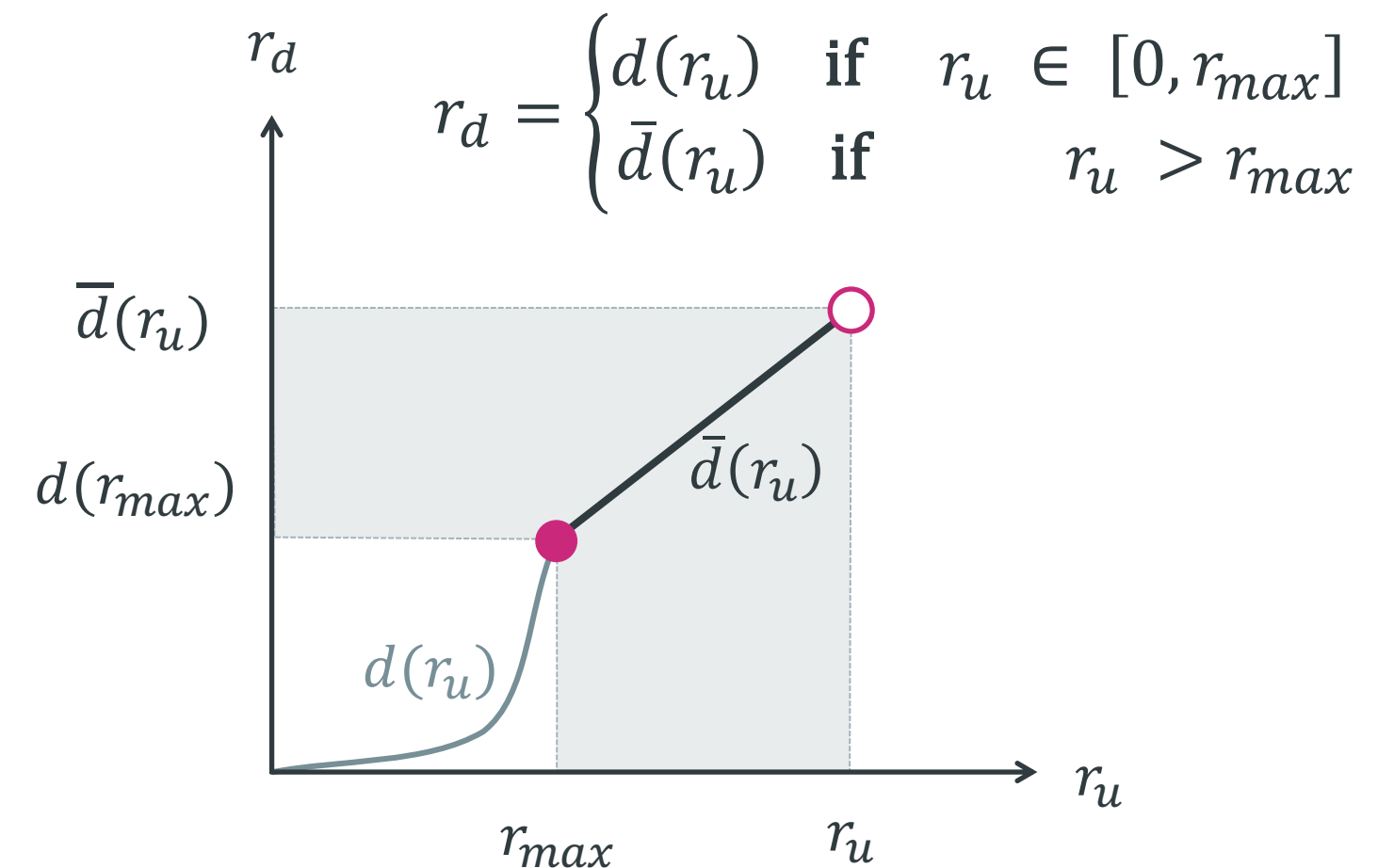
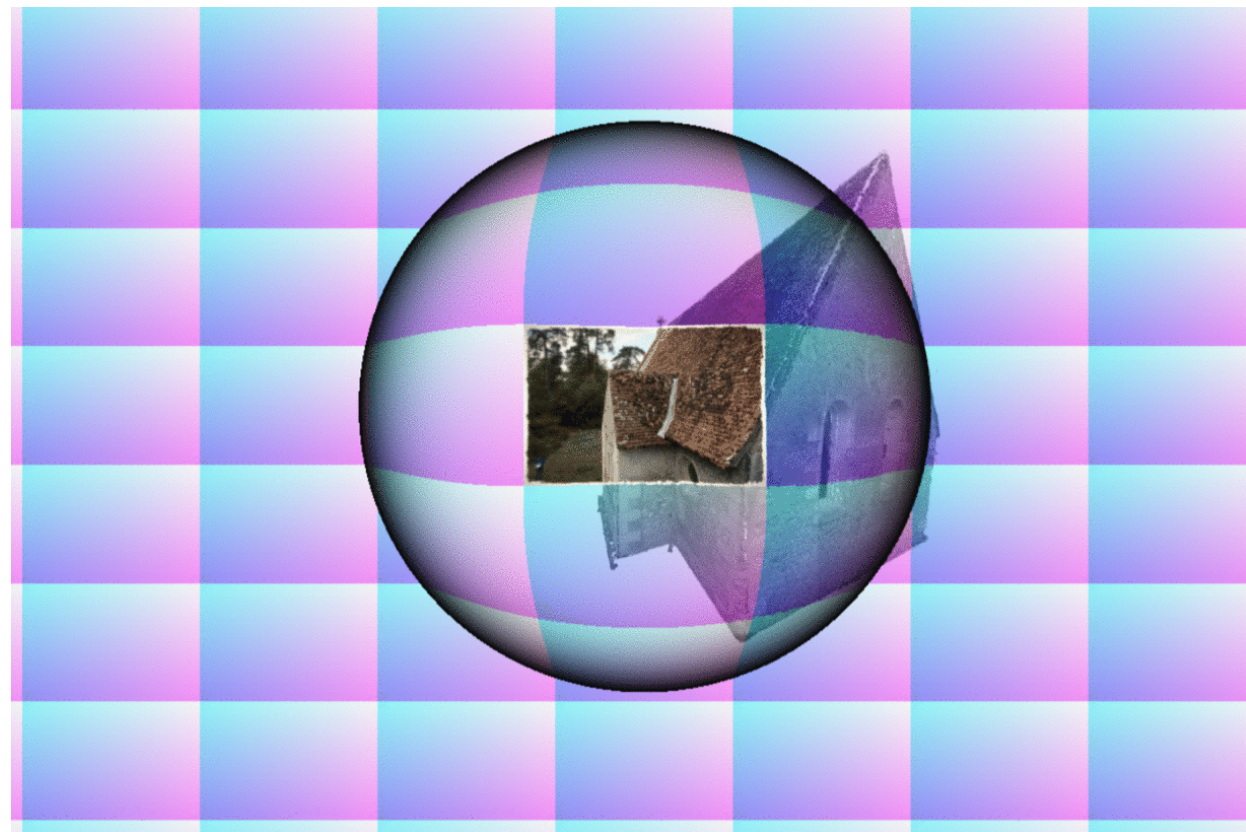
A small change in our coordinates.  
(i.e. related in this case to our optical lens).





# DISTORTION OBJECTIVE

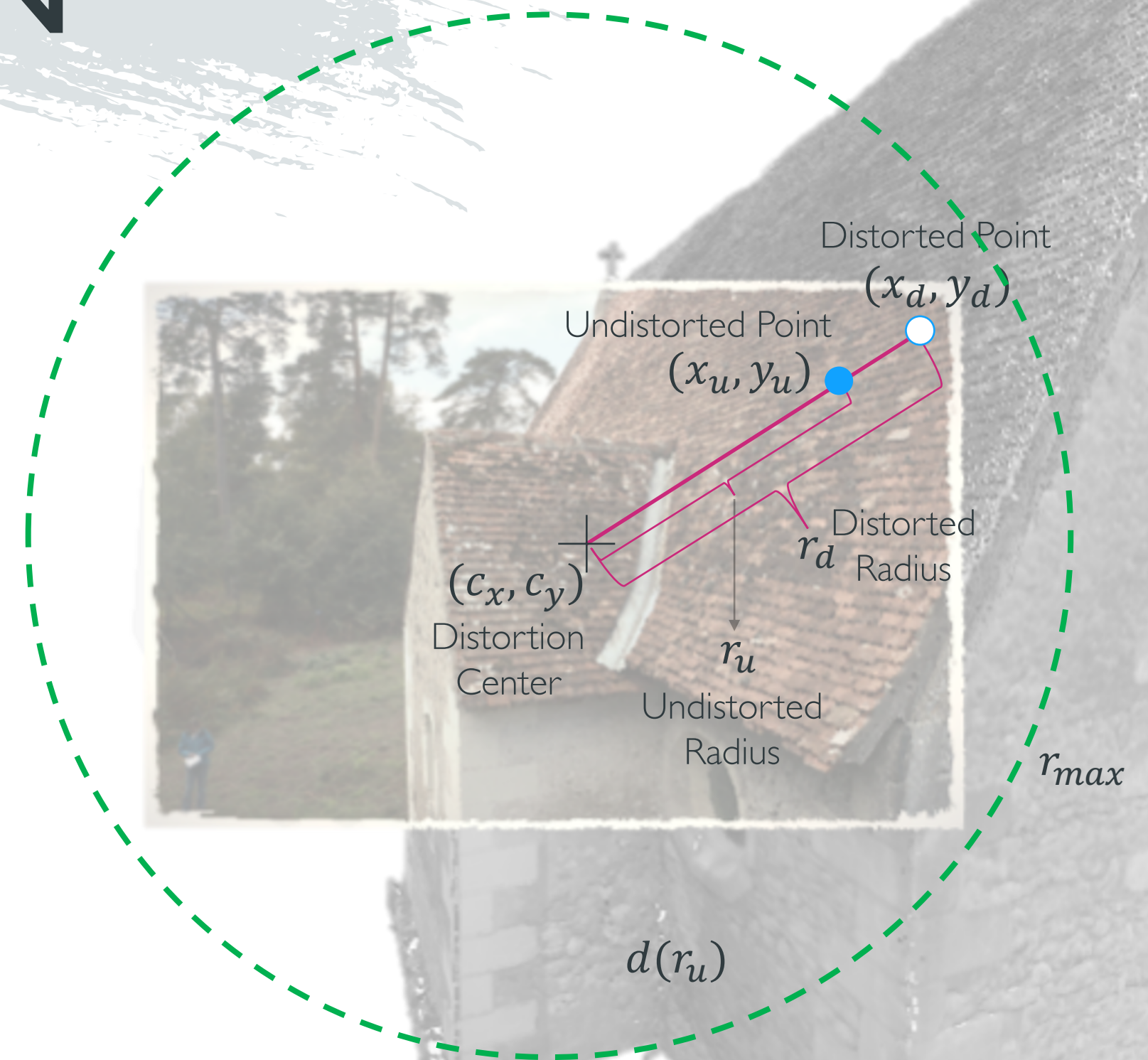
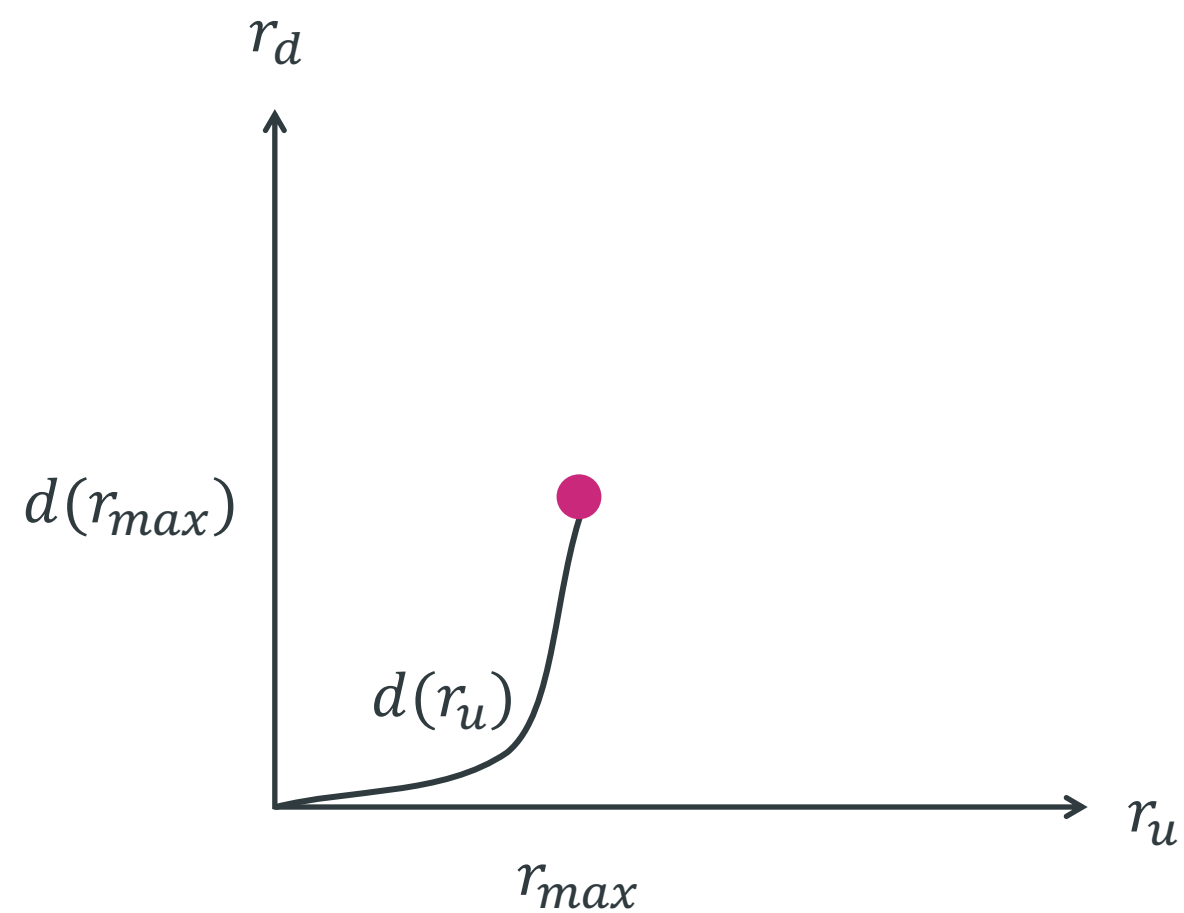
A continuous distortion function that can be used in both historical and view cameras.



# DISTORTION METHOD

## FUNCTION DEFINITION

$$r_d = \begin{cases} d(r_u) & \text{if } r_u \in [0, r_{max}] \\ \bar{d}(r_u) & \text{if } r_u > r_{max} \end{cases}$$

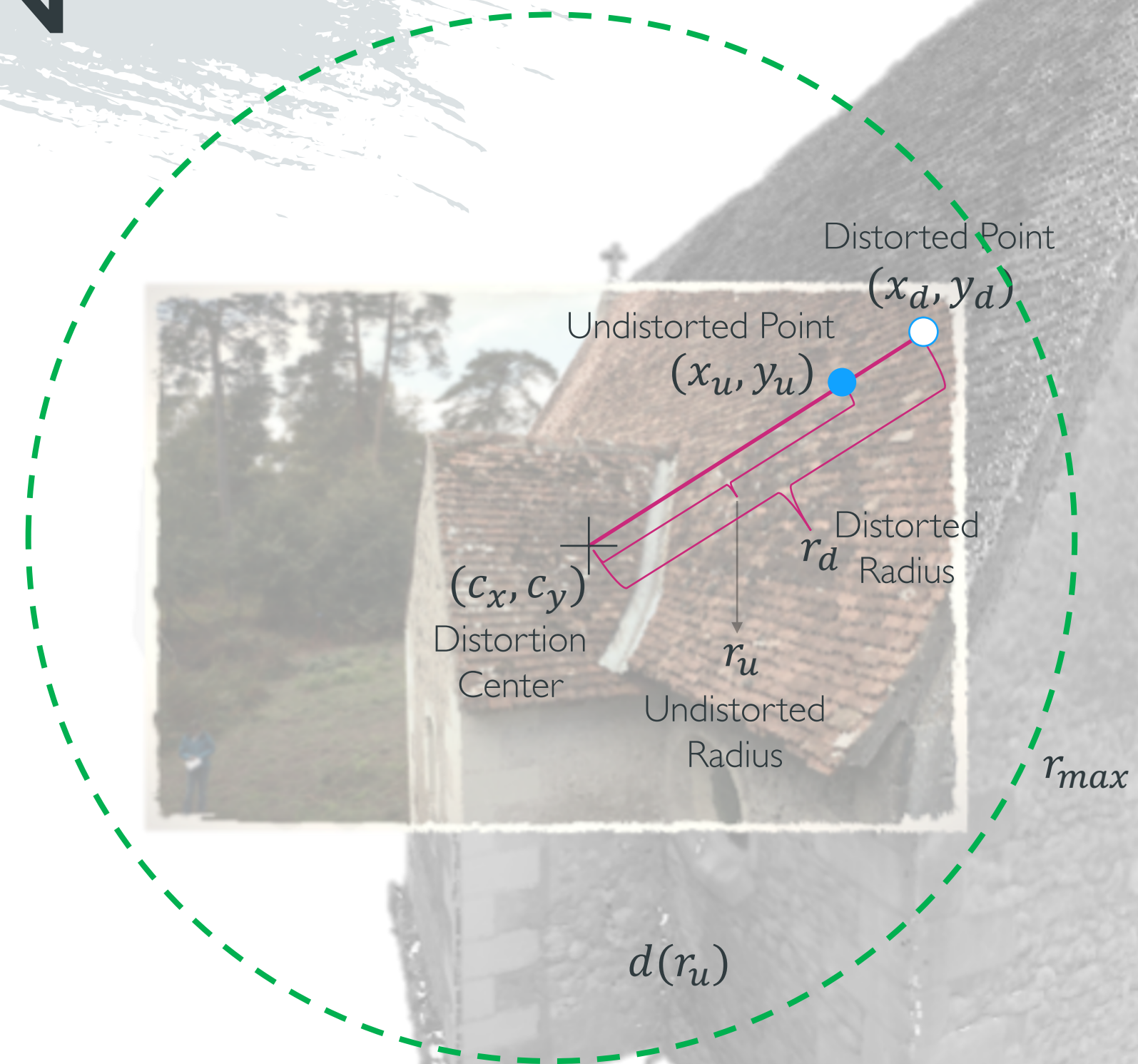
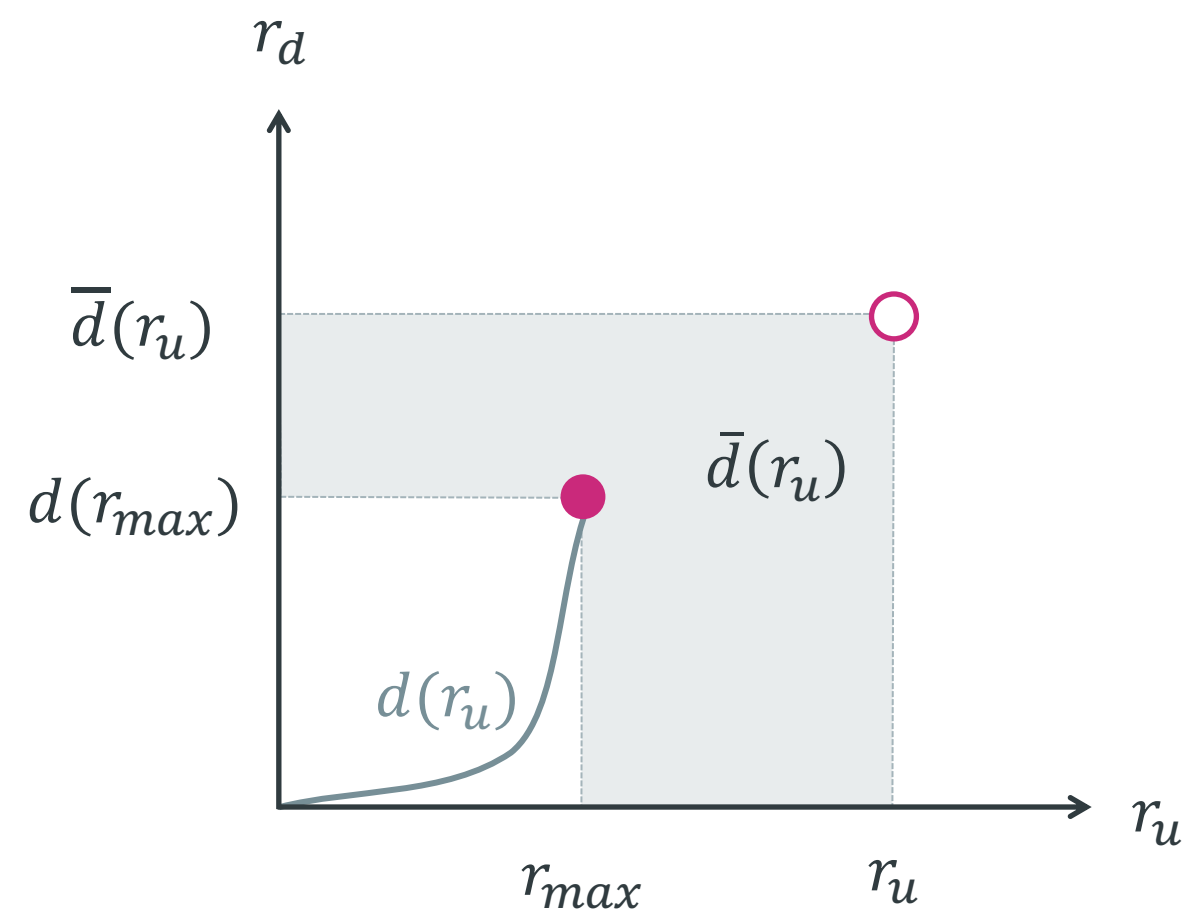




# DISTORTION METHOD

## FUNCTION DEFINITION

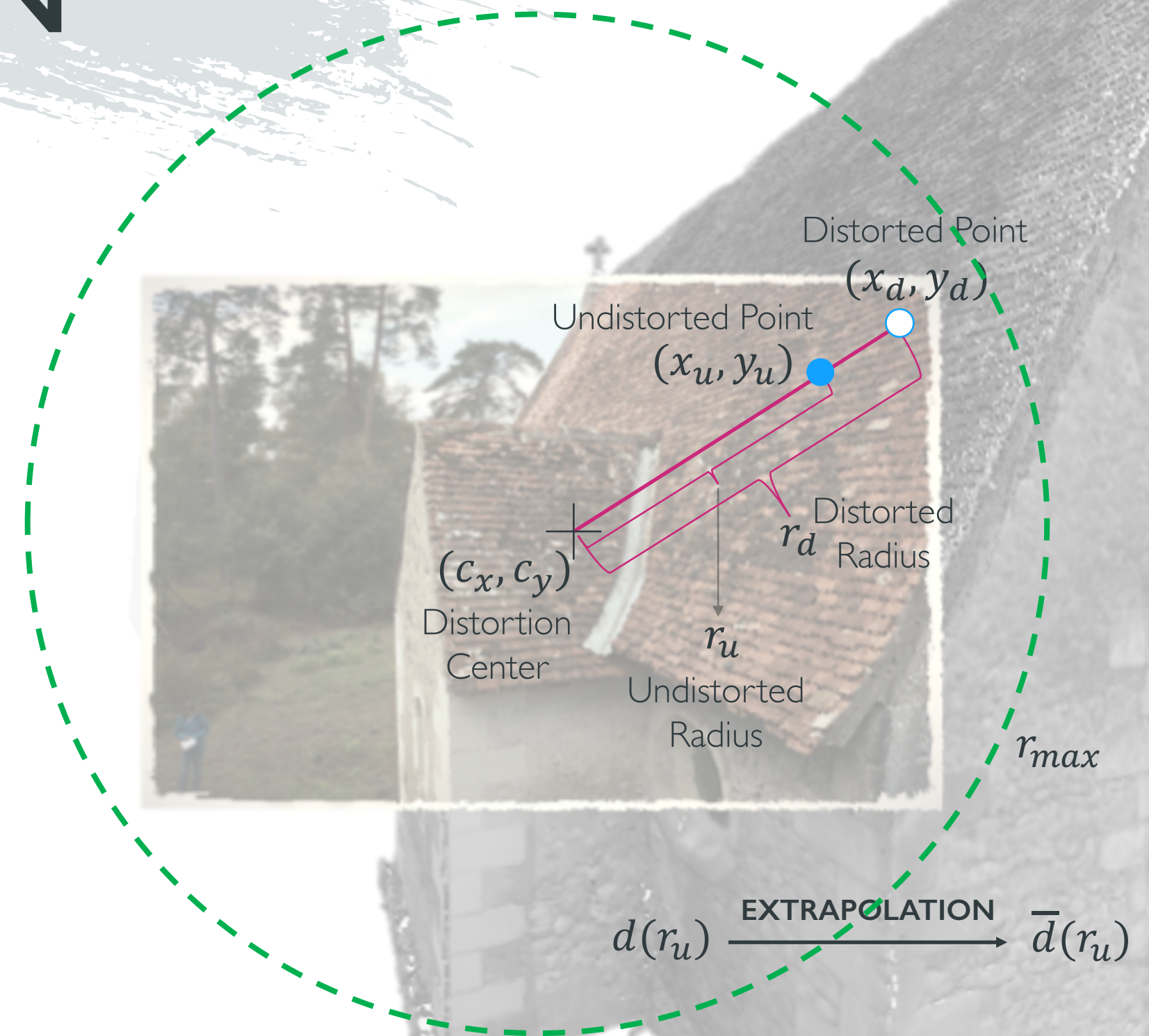
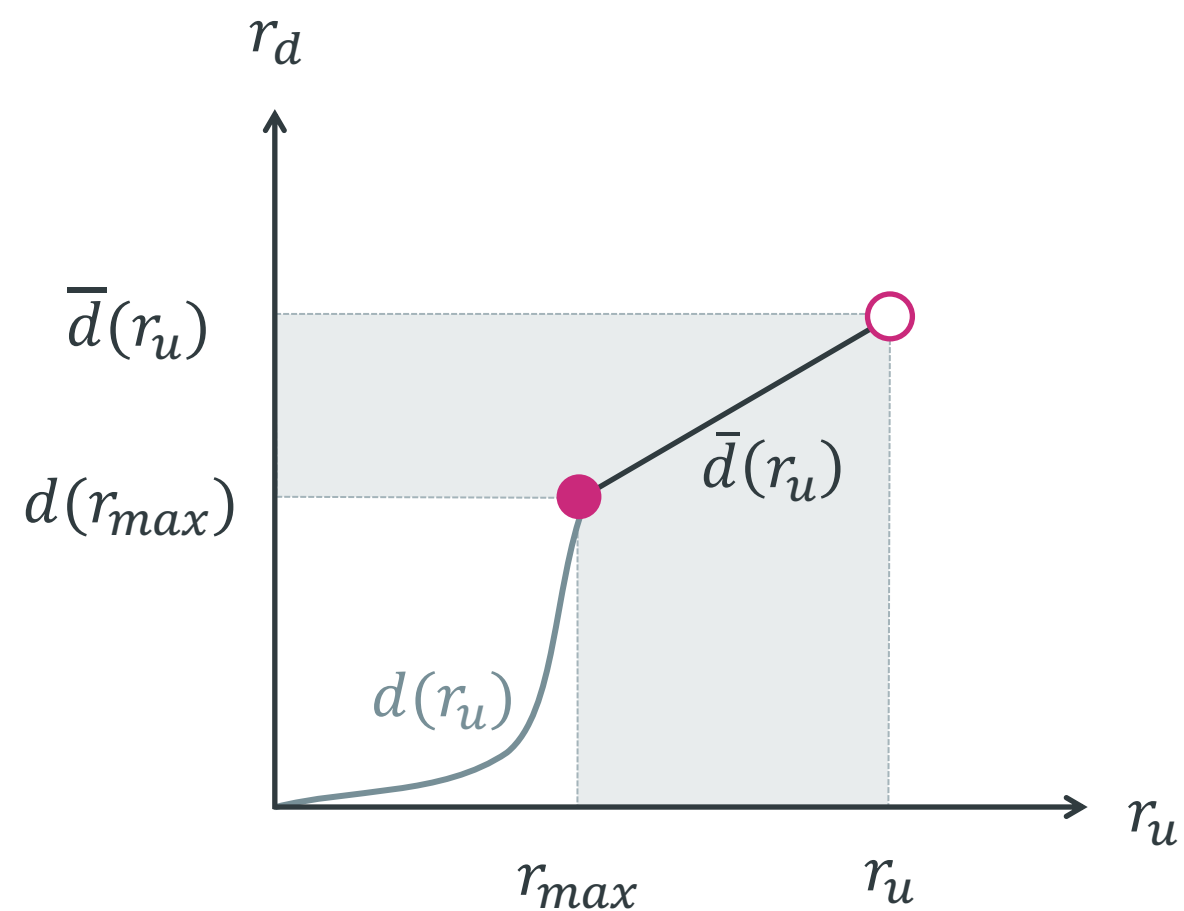
$$r_d = \begin{cases} d(r_u) & \text{if } r_u \in [0, r_{max}] \\ \bar{d}(r_u) & \text{if } r_u > r_{max} \end{cases}$$



# DISTORTION METHOD

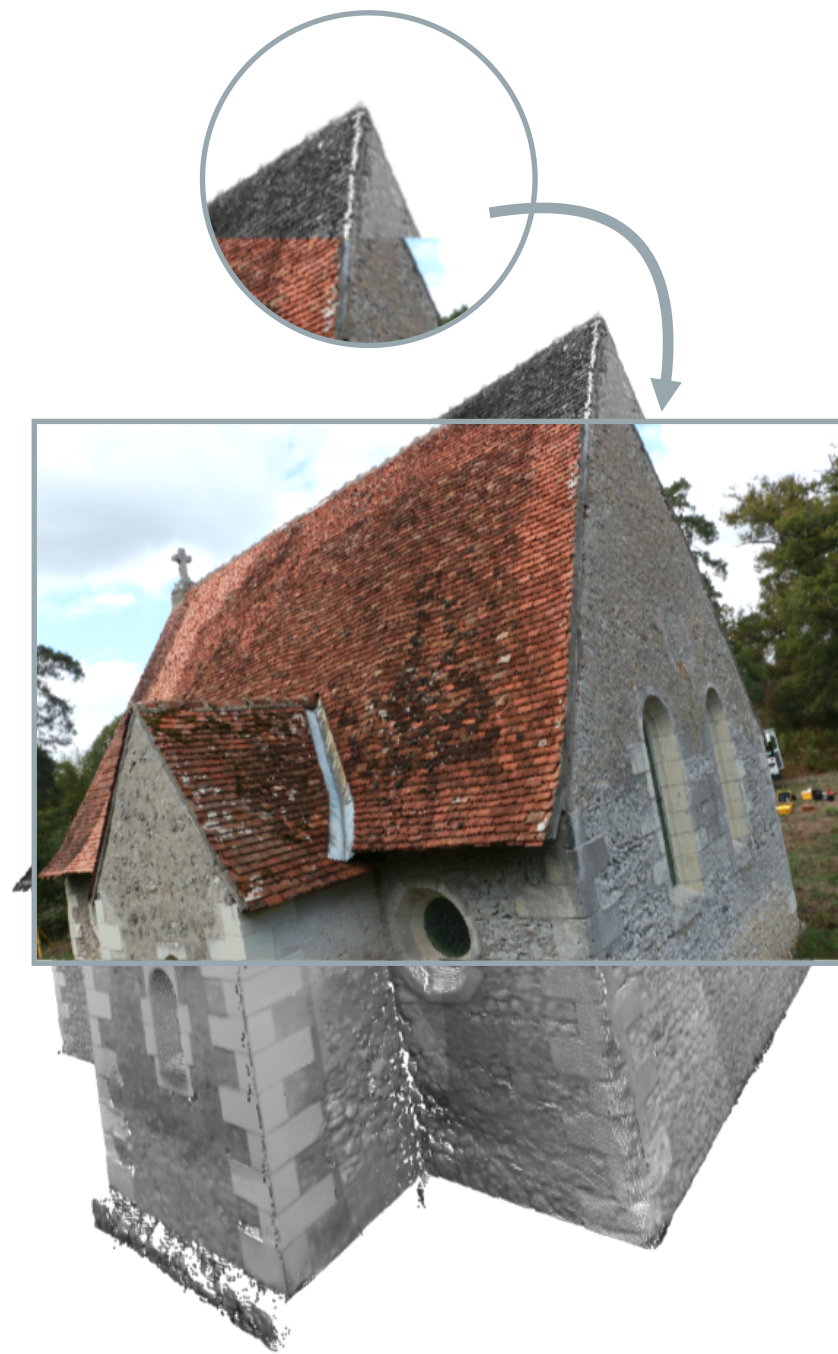
## FUNCTION DEFINITION

$$r_d = \begin{cases} d(r_u) & \text{if } r_u \in [0, r_{max}] \\ \bar{d}(r_u) & \text{if } r_u > r_{max} \end{cases}$$

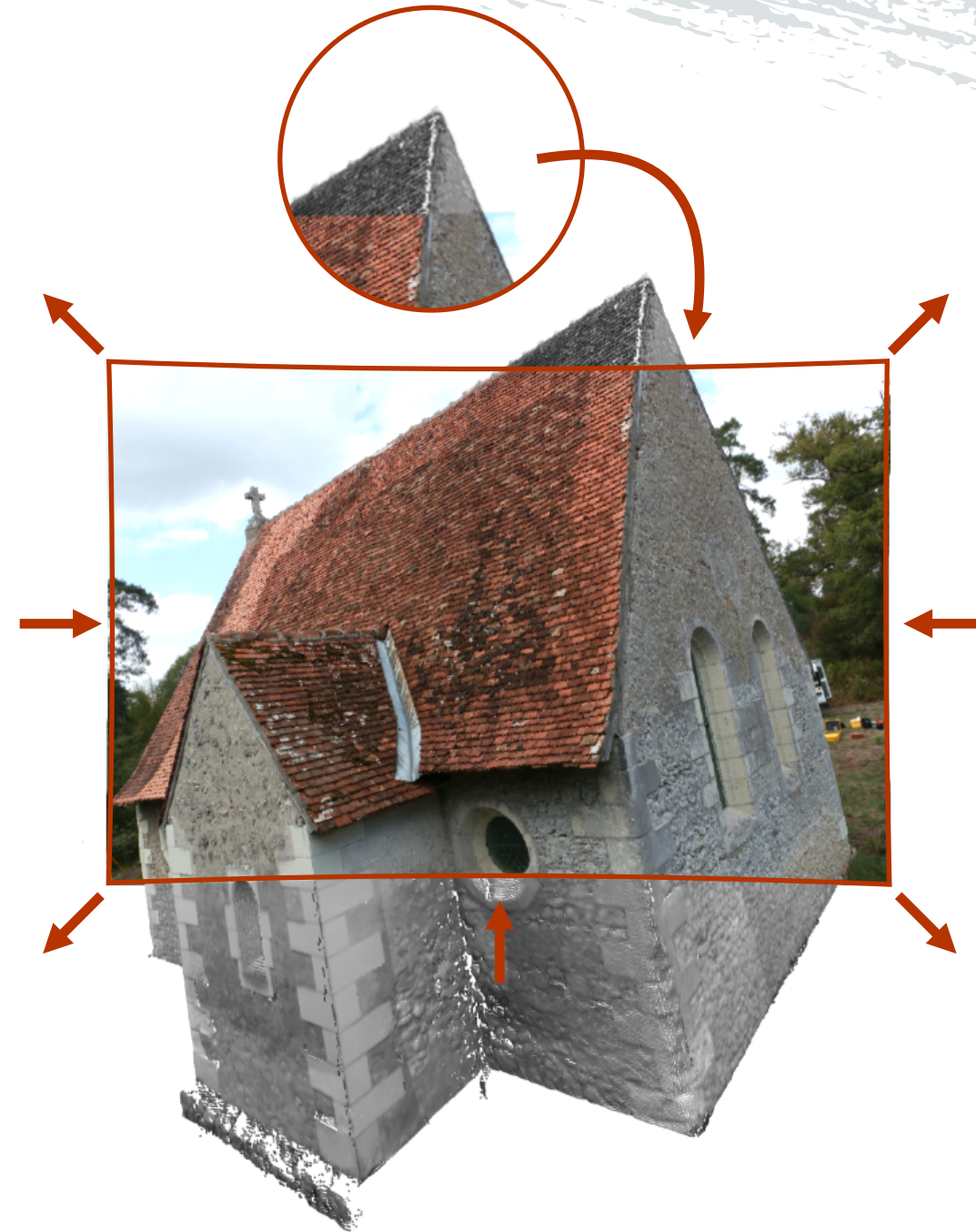




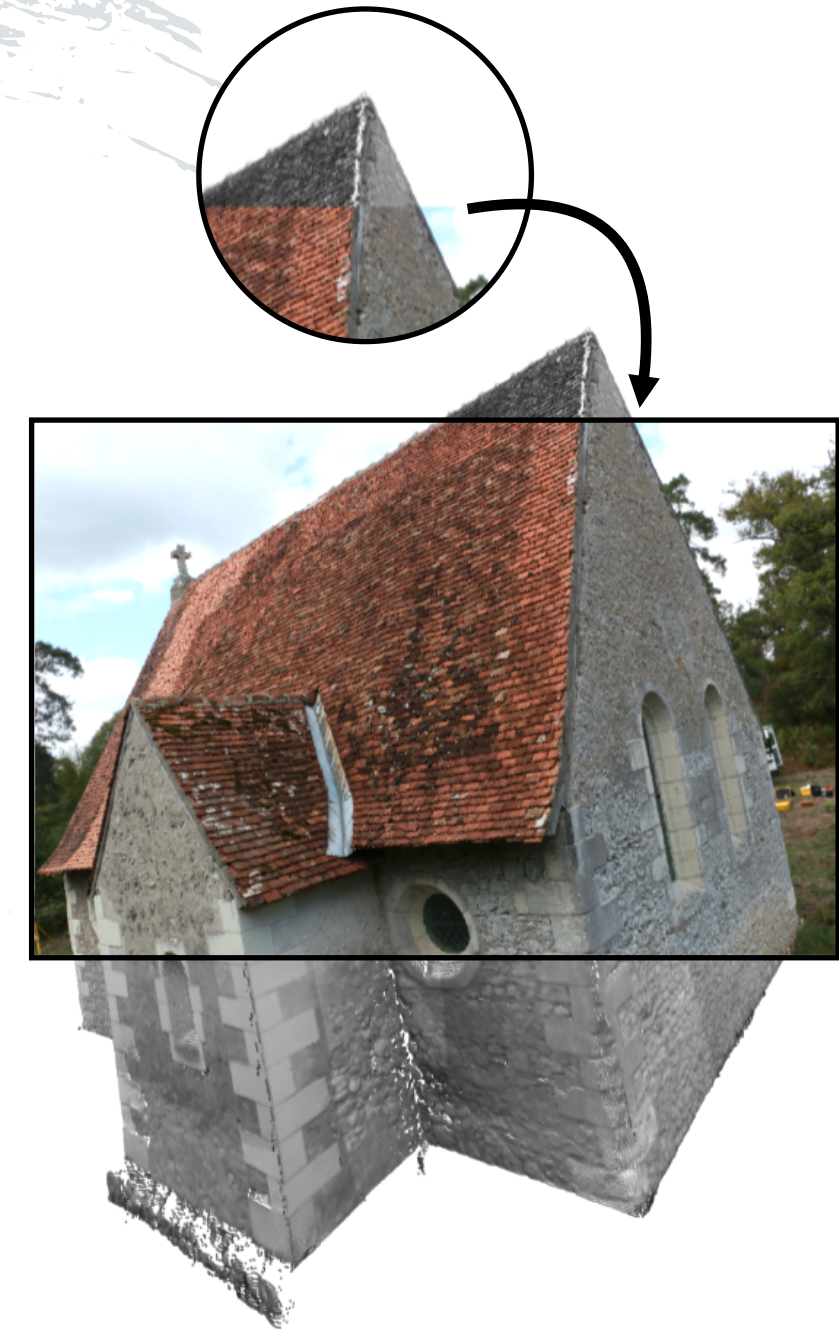
# DISTORTION RESULT



View Camera: Pinhole model  
Historical Camera: Pinhole model



View Camera: Pinhole model  
Historical Camera: Distorted model



View Camera: Distorted model  
Historical Camera: Distorted model



# DISTORTION

## RESULT

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# THANK YOU!

ANY QUESTIONS?

## Contact

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Sidonie Christophe [sidonie.christophe@ign.fr](mailto:sidonie.christophe@ign.fr)  
Mathieu Bredif [mathieu.bredif@ign.fr](mailto:mathieu.bredif@ign.fr)

<https://umrlastig.github.io/geovis>

Project ANR ALEGORIA n°ANR-17-CE38-0014-01

