

# IMAGE BASED RENDERING OF LARGE HISTORICAL IMAGE COLLECTION

Evelyn Paiz Reyes

LASTIG, Univ Gustave Eiffel, ENSG, IGN, F-94160 Saint-Mandé, France

# OUTLINE

01

02

03

04

05

CONTEXT OF RESEARCH

INTRODUCTION

PROBLEM STATEMENT

OBJECTIVE

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"

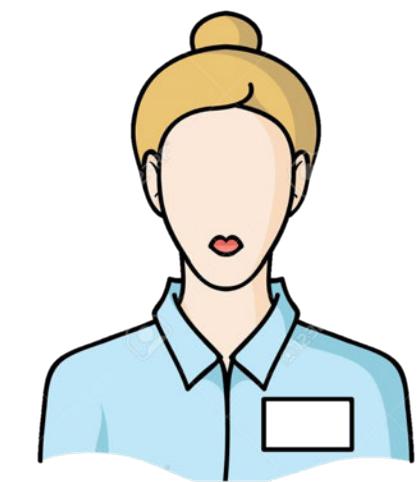
# CONTEXT OF RESEARCH

## 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	Combier	image	postcards	randomly	1949-1974	10000	
	Bouquet		army	vertical	1914-1918	49	
	Bron	image	aerial	vertical and oblique	1924-1926	130	
	Falba			vertical	1951-1960	550	
	Henrad		aerial	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



User

Archivists, Historians and  
Researchers in Humanities

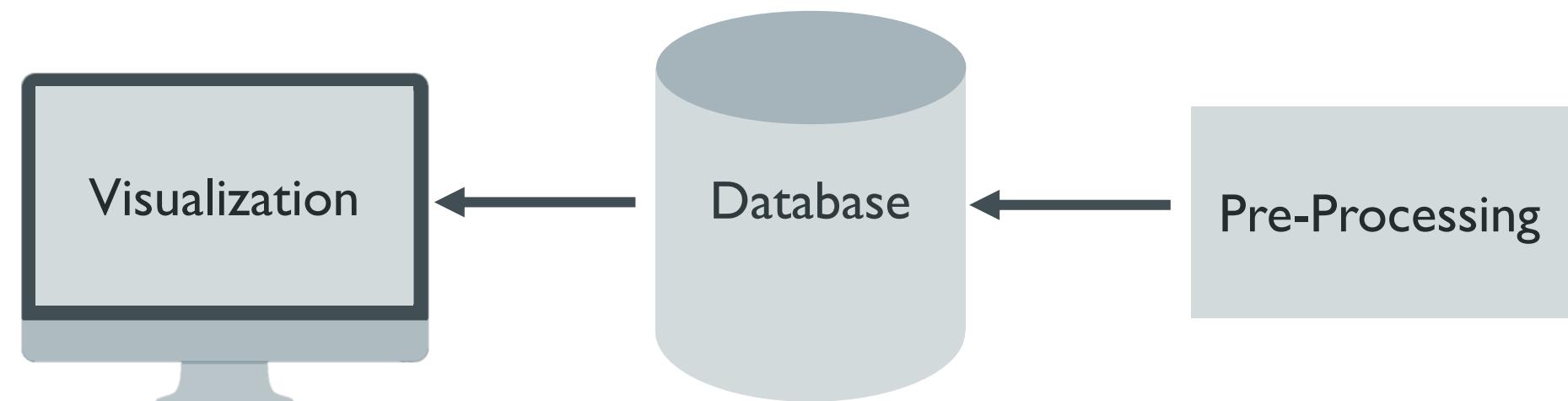
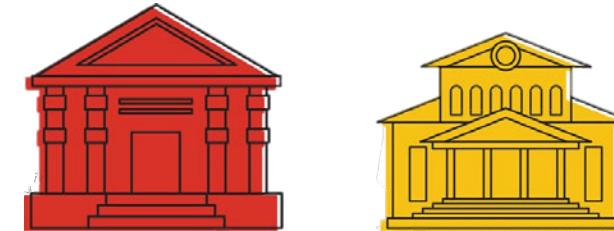


Image Based Rendering or Large Historical Image Collection

GLAM



Galleries, Libraries,  
Archives and Museums



Dataset

Street Level and Aerial Photographs,  
Lidiar Data, etc.

# CONTEXT OF RESEARCH

## SYSTEM



User

Archivists, Historians and  
Researchers in Humanities

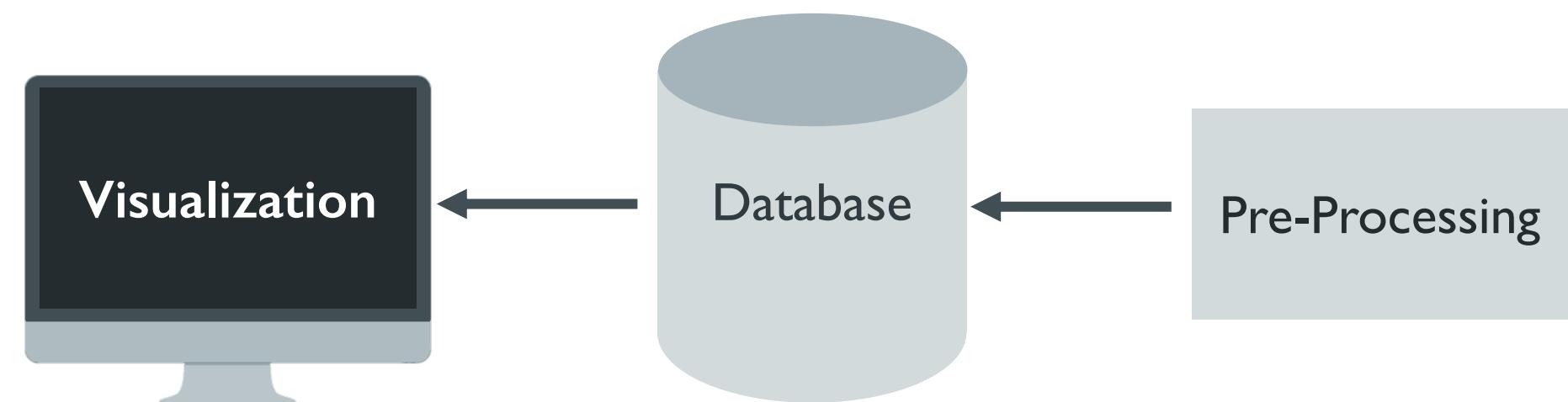
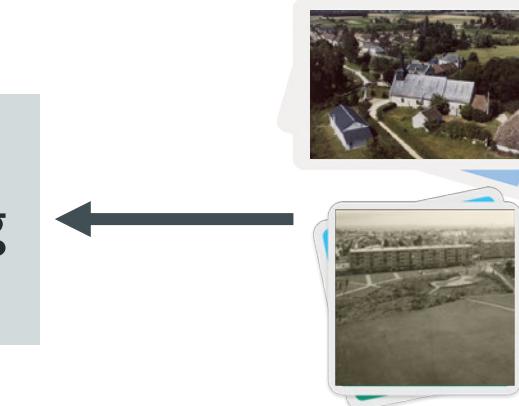


Image Based Rendering or Large Historical Image Collection

GLAM



Galleries, Libraries,  
Archives and Museums

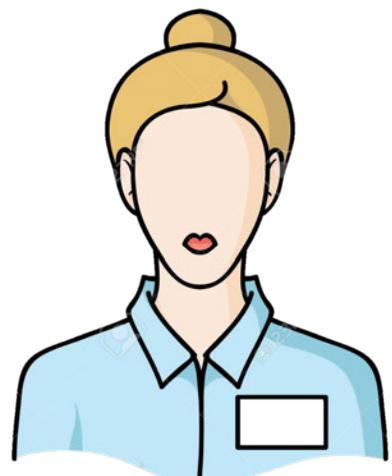


Dataset

Street Level and Aerial Photographs,  
Lidiar Data, etc.

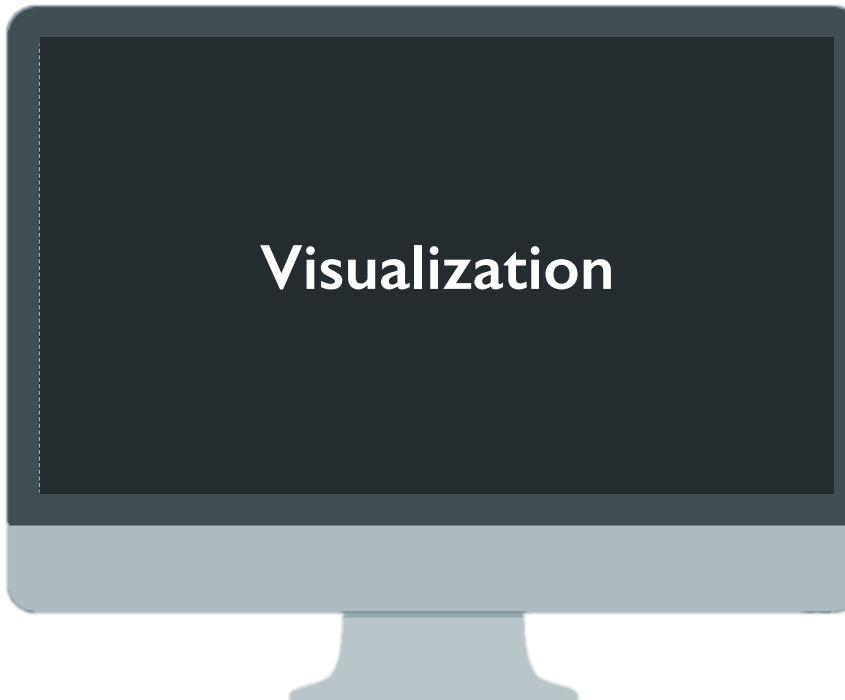
# INTRODUCTION

## EXISTING TOOLS



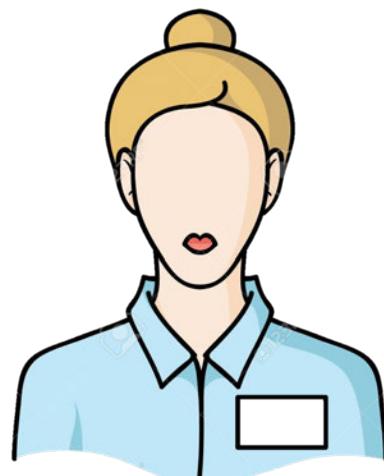
User

Archivists, Historians and  
Researchers in Humanities



# INTRODUCTION

## EXISTING TOOLS - PHOTO LIBRARY



User

Archivists, Historians and  
Researchers in Humanities

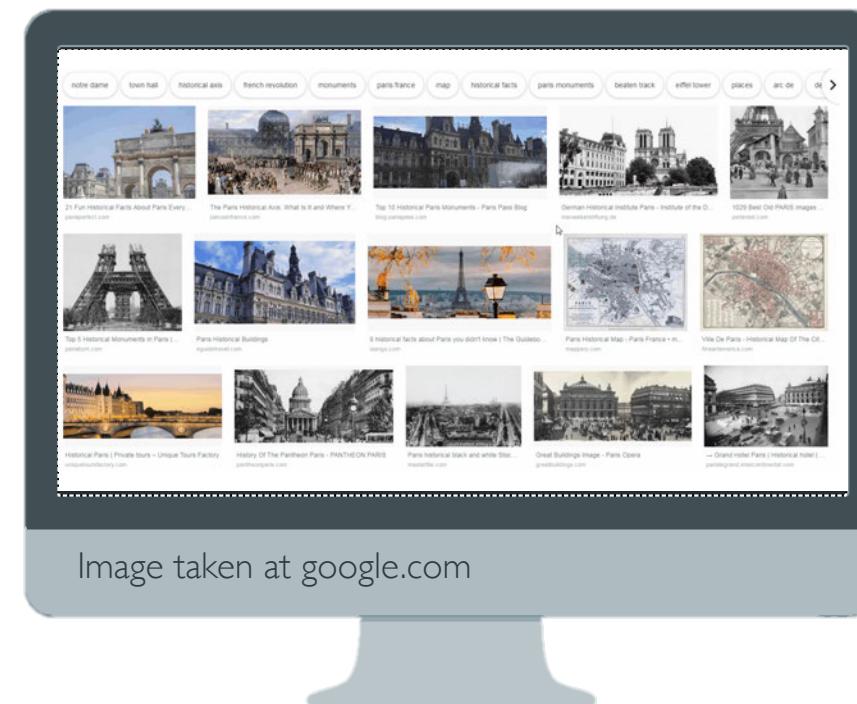
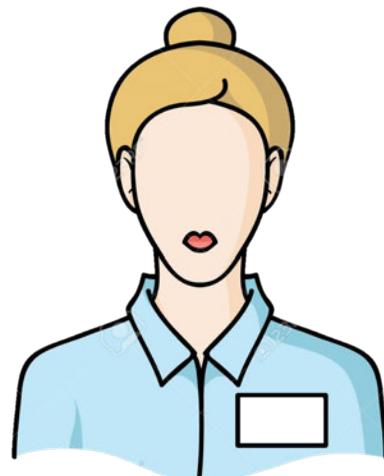


Image Based Rendering or Large Historical Image Collection

# INTRODUCTION

## EXISTING TOOLS - PIXPLOT



User

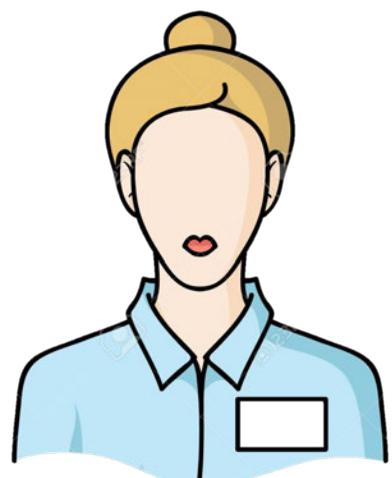
Archivists, Historians and  
Researchers in Humanities



Image taken at pixplot.com

# INTRODUCTION

## EXISTING TOOLS - HISTORYPIN



User

Archivists, Historians and  
Researchers in Humanities

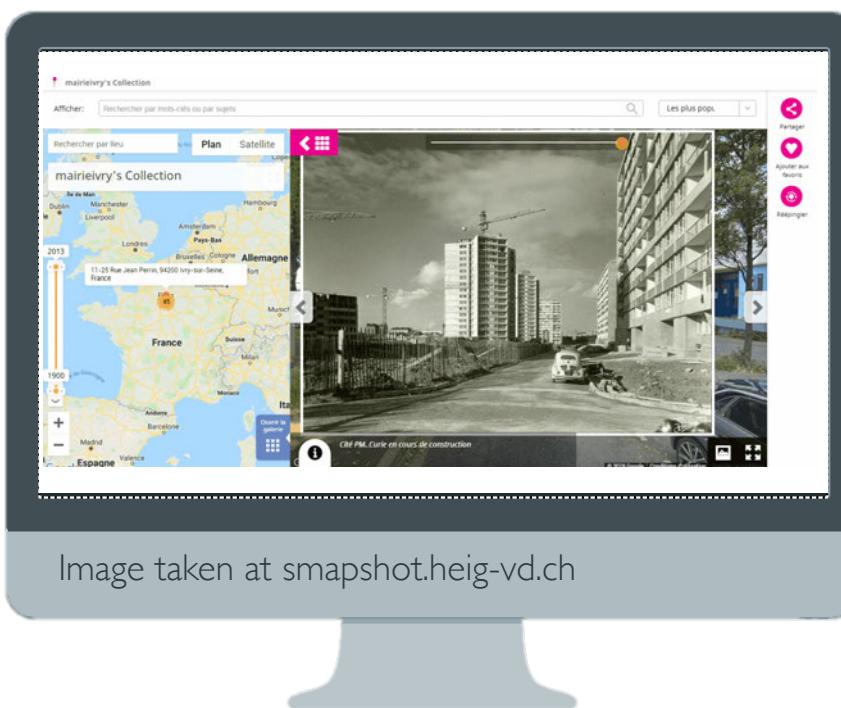


Image taken at snapshot.heig-vd.ch

# INTRODUCTION

## EXISTING TOOLS - SMAPSHOT



User

Archivists, Historians and  
Researchers in Humanities

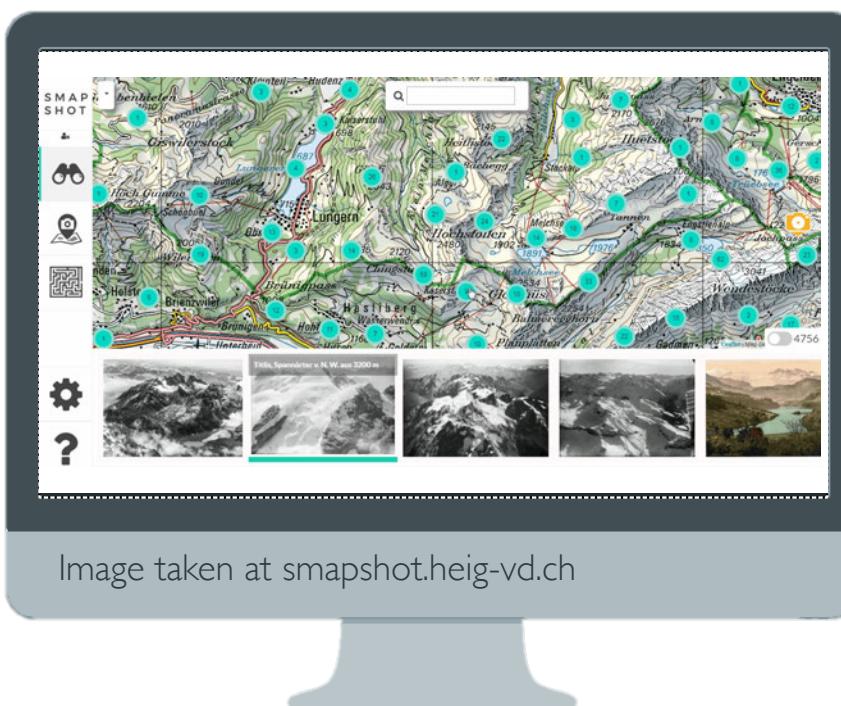


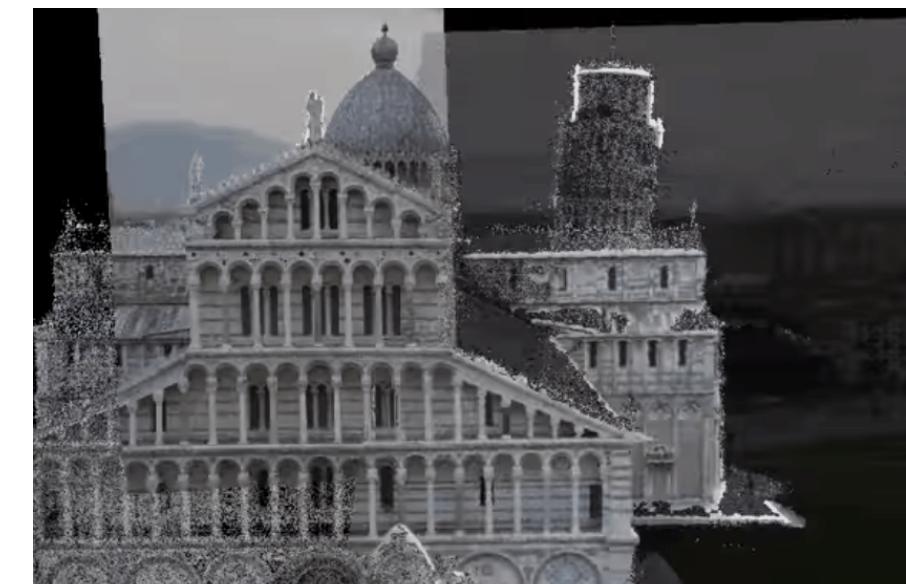
Image Based Rendering or Large Historical Image Collection

# 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.

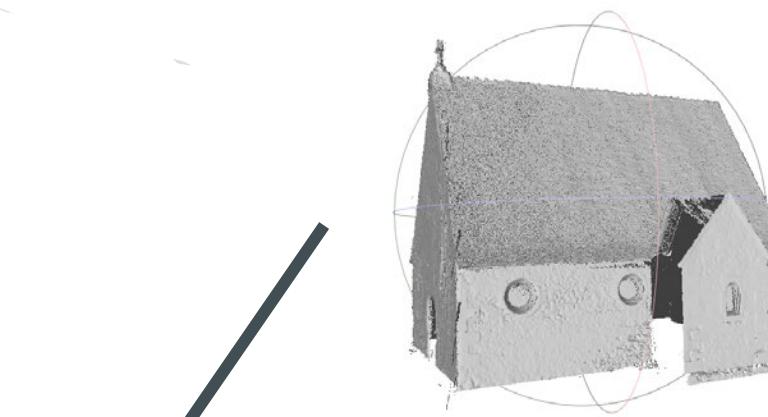
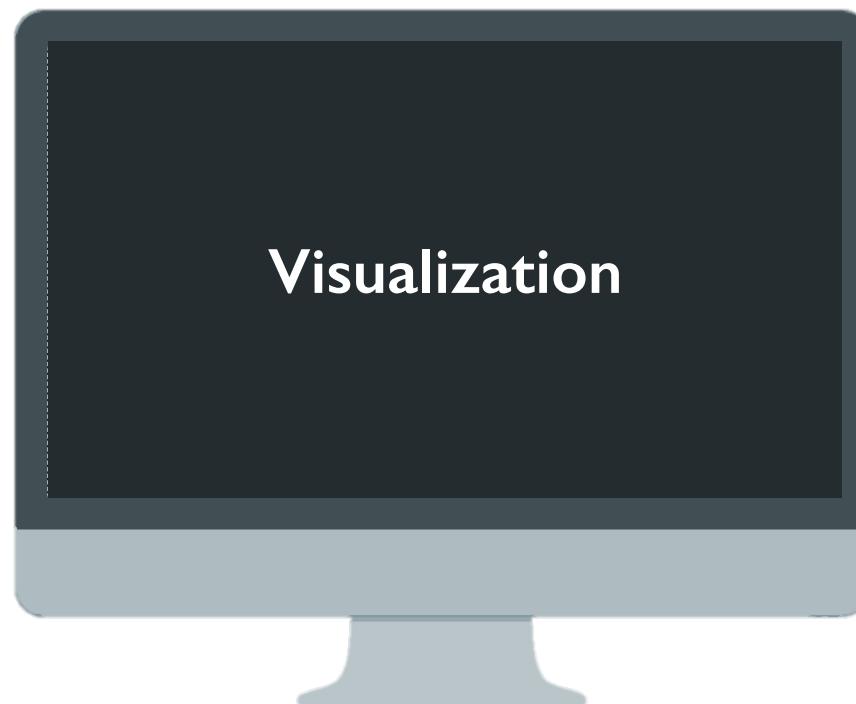
# INTRODUCTION

## RENDERING



User

Archivists, Historians and  
Researchers in Humanities



3D  
Geometry

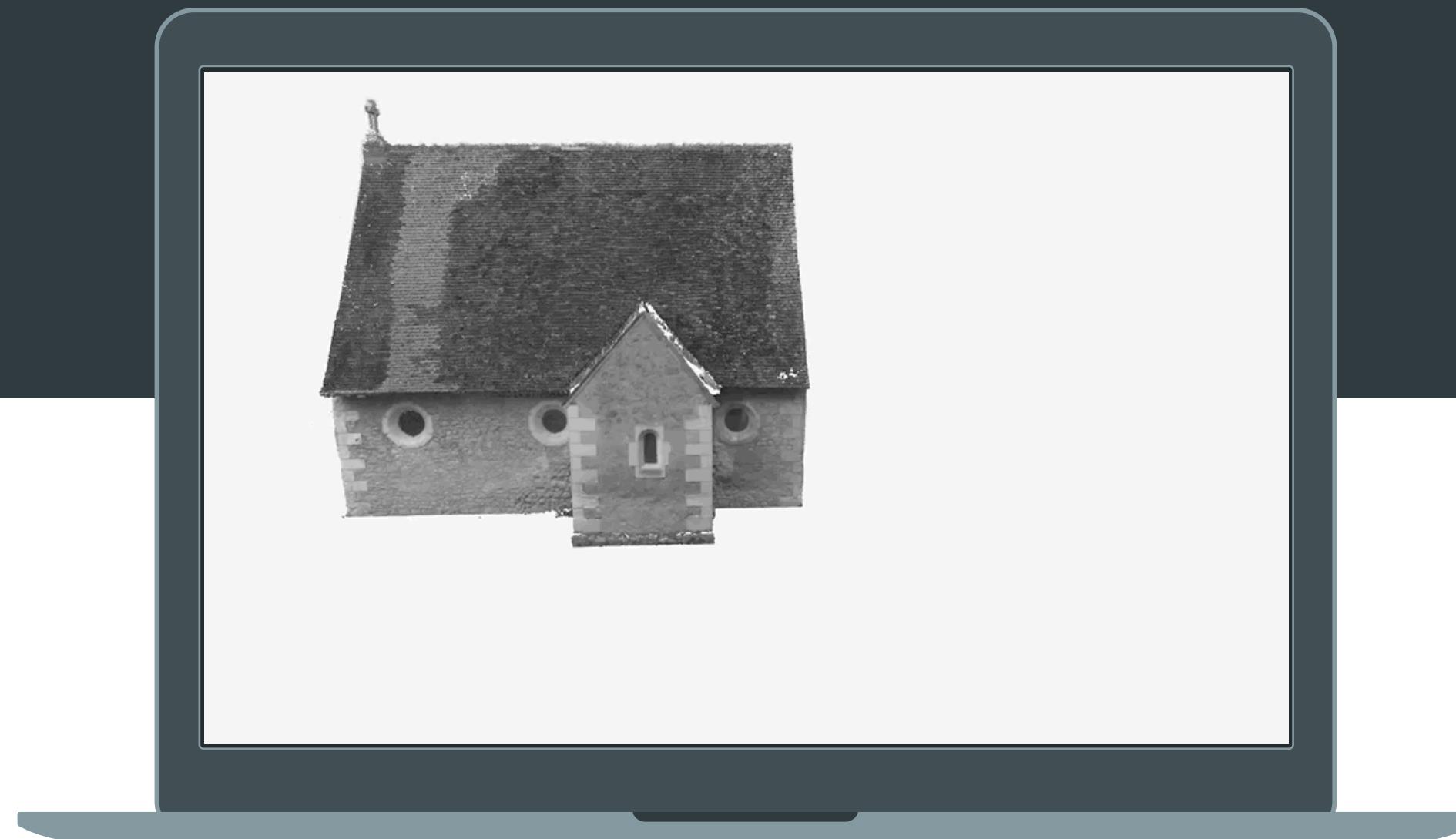


Historical  
Photograph



Orientation  
Data

# INTRODUCTION



## CAMERA DEFINITION



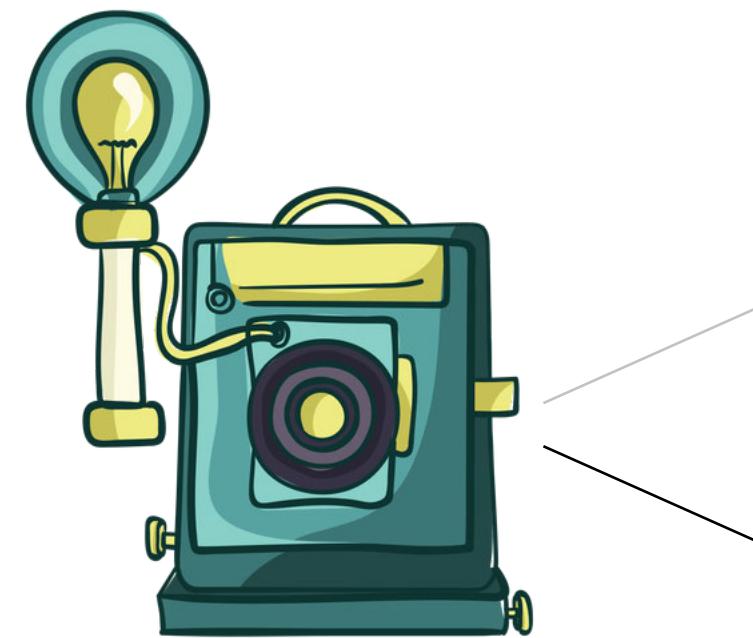
Pinhole Camera Model

**View Camera**

# INTRODUCTION



## CAMERA DEFINITION



Pinhole Camera Model

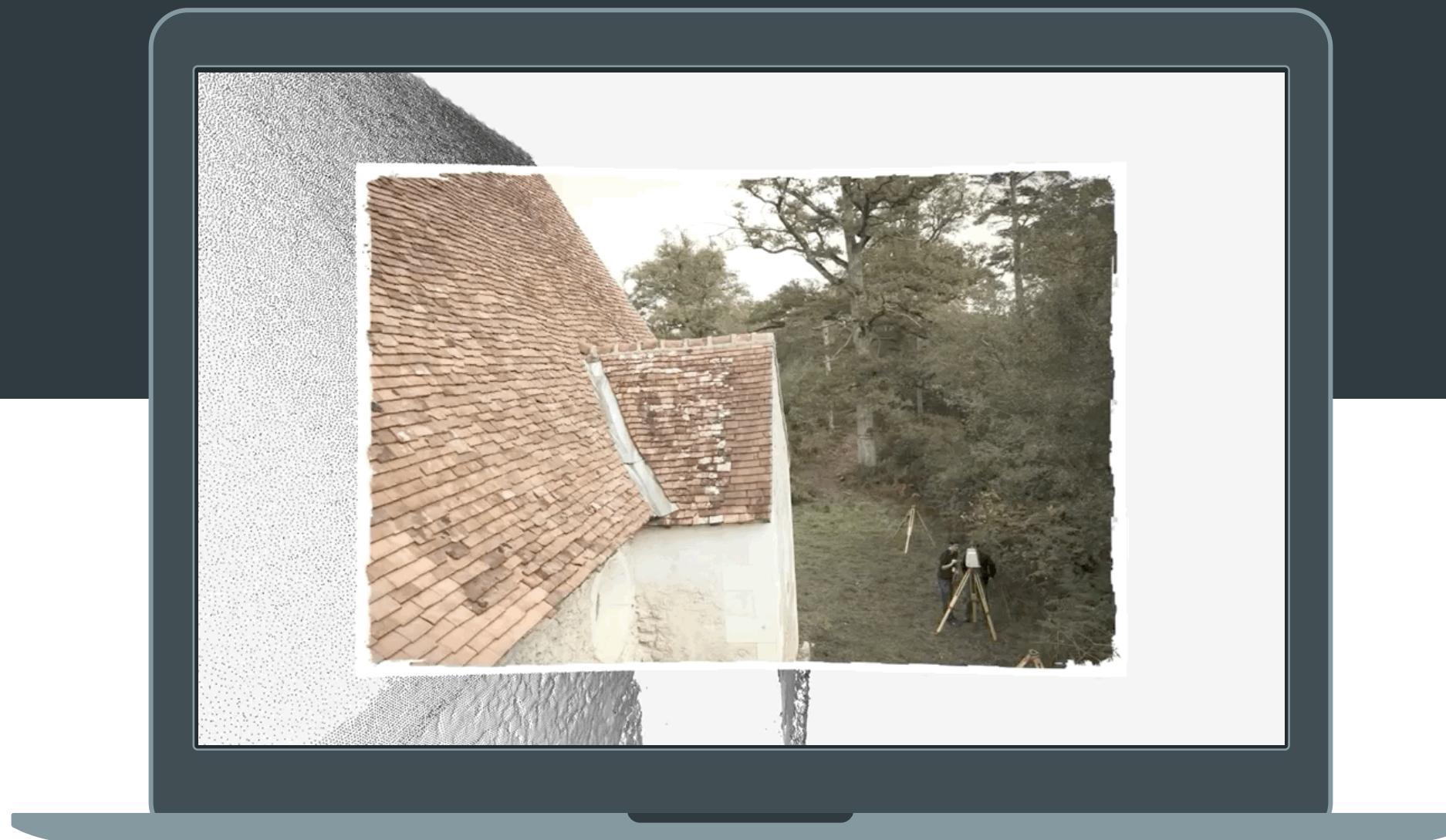
View Camera



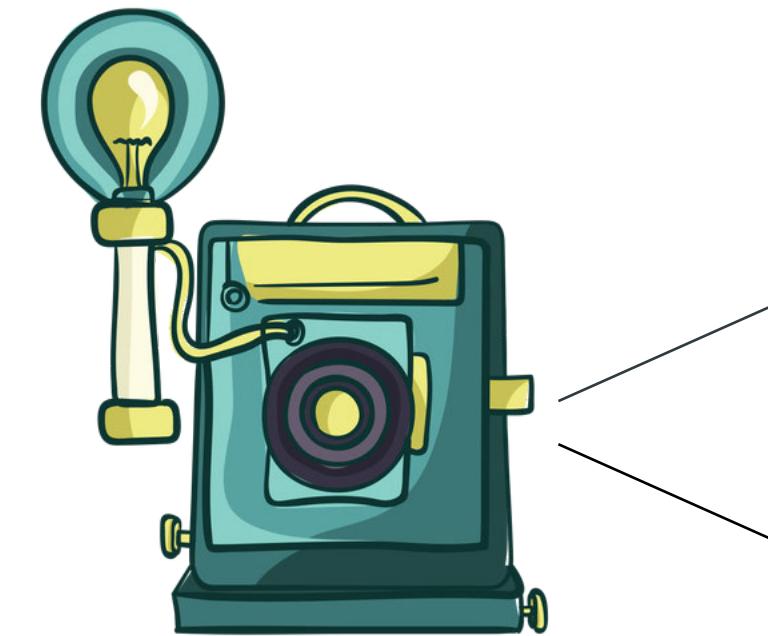
Historical Camera

Distorted Camera  
Model

# INTRODUCTION



## PROJECTIVE TEXTURING



Pinhole Camera Model

**View Camera**



**Historical Camera**

Distorted Camera  
Model

# PROBLEM STATEMENT

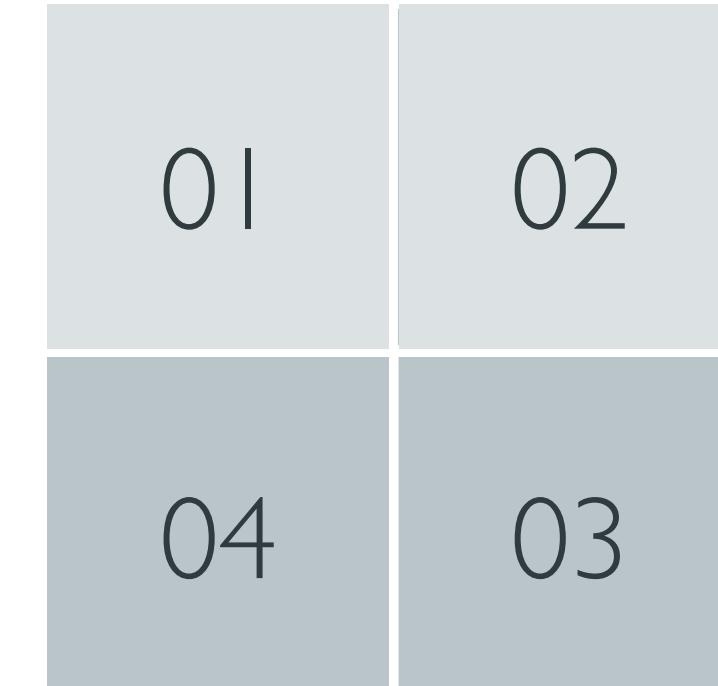
Leave the images untouched but still make them fit the 3D surrounding?

DISTORTION

NAVIGATION

Explore a massive image collections?

**ARTIFACT CORRECTION**



**GRAPHIC REPRESENTATION**

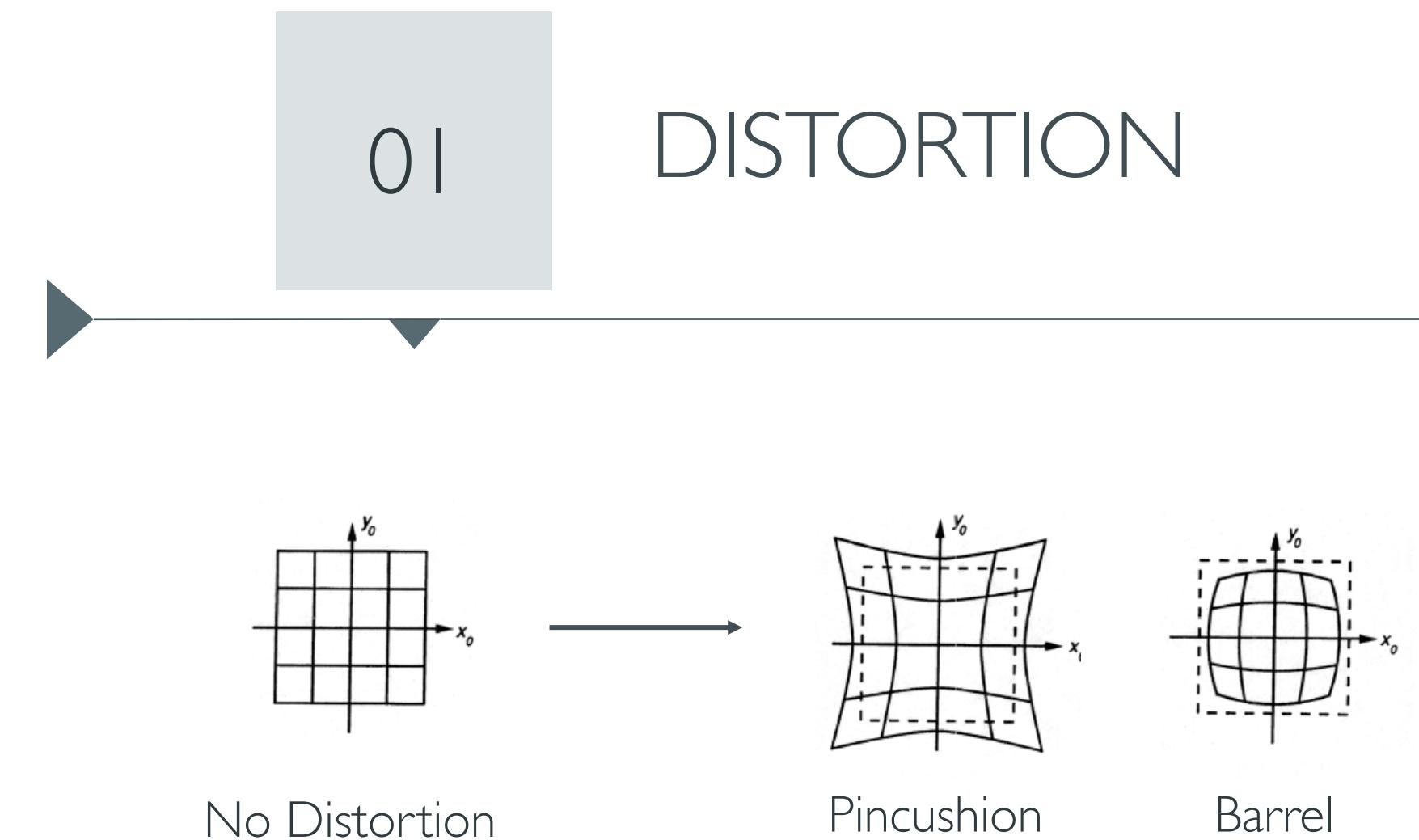
Avoid artifacts and misalignments between photographs and the scene?

UNCERTAINTY

RADIOMETRY

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

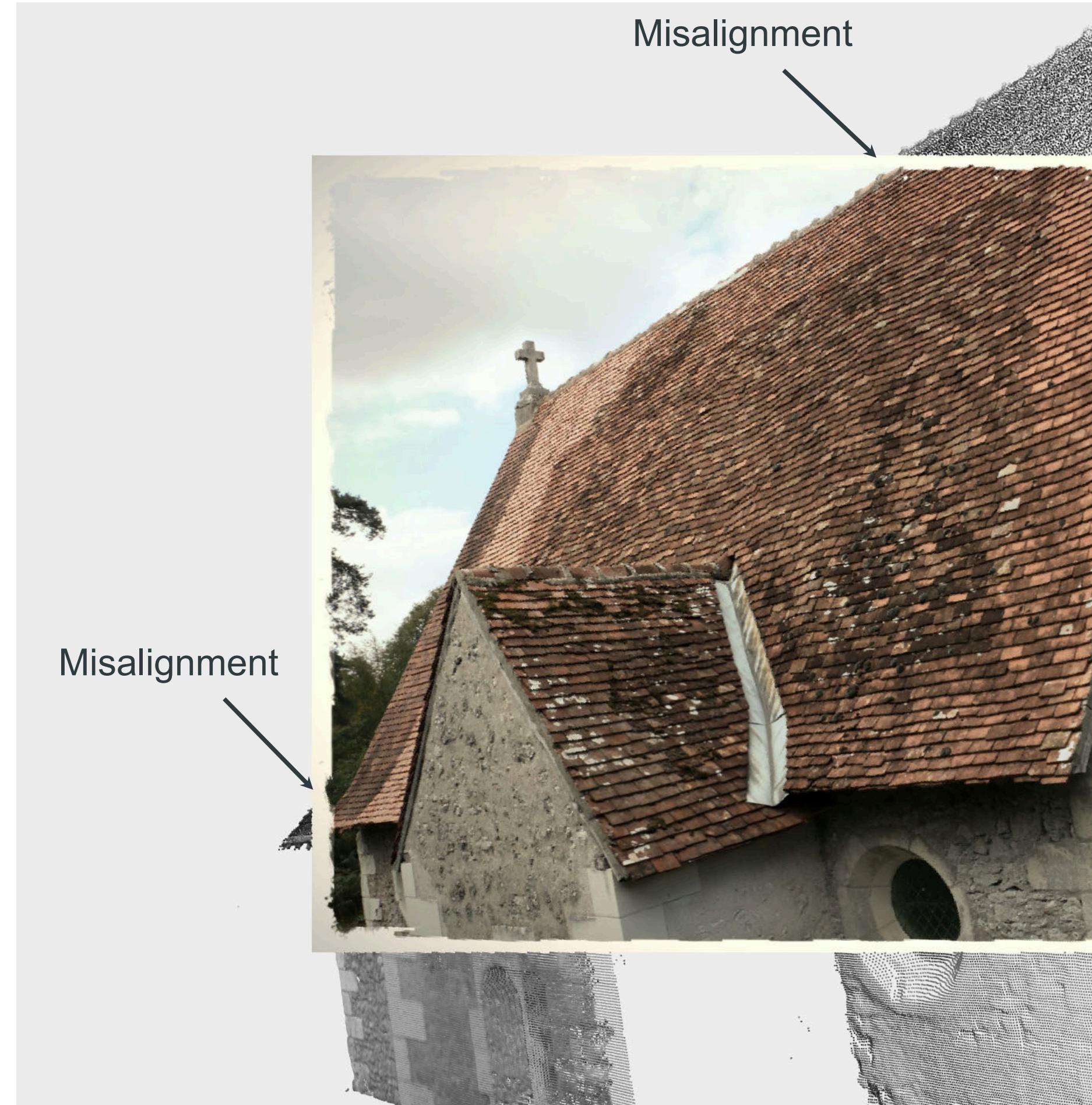
# PROBLEM STATEMENT



# PROBLEM STATEMENT

02

UNCERTAINTY





03

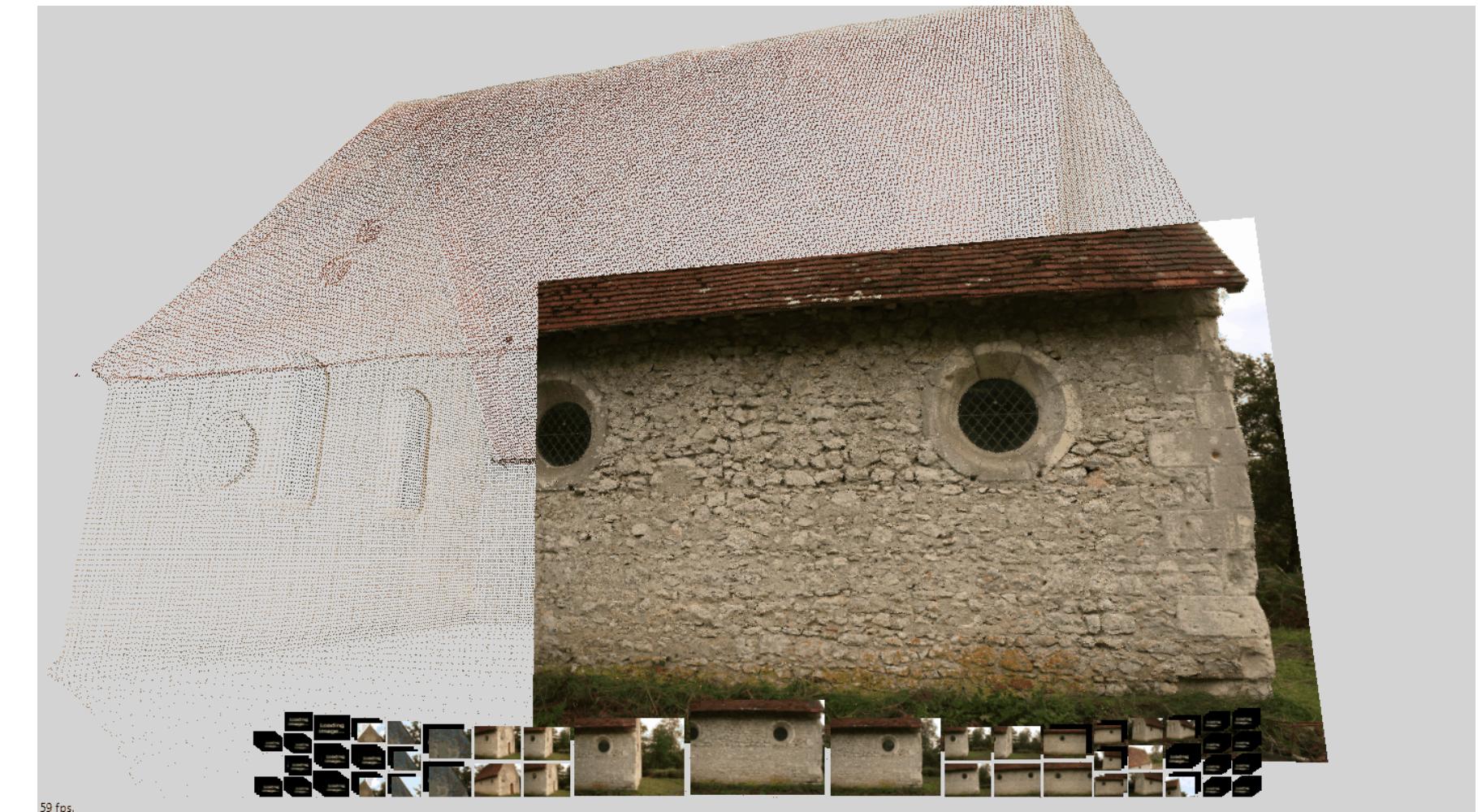
RADIOMETRY

# 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.

# RESEARCH OBJECTIVE

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

Itowns and BD TOPO © IGN 2019

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



# RESEARCH APPROACH

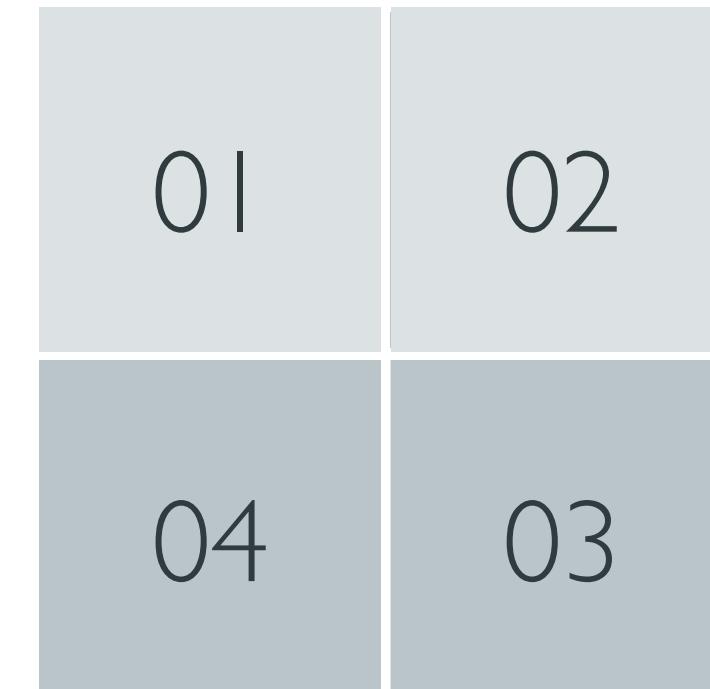
Leave the images untouched but still make them fit the 3D surrounding?

DISTORTION

NAVIGATION

Explore a massive image collections?

**ARTIFACT CORRECTION**



**GRAPHIC REPRESENTATION**

Avoid artifacts and misalignments between photographs and the scene?

UNCERTAINTY

RADIOMETRY

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

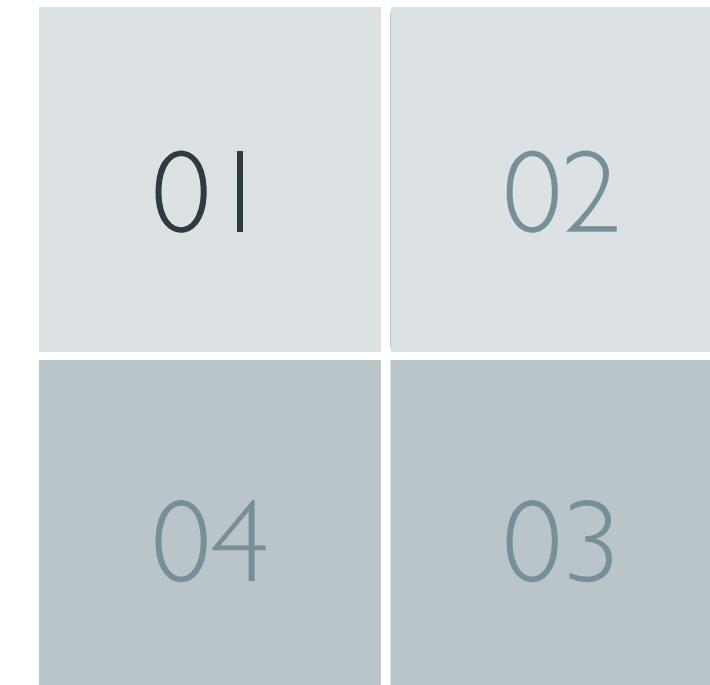
# RESEARCH APPROACH

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

DISTORTION

Explore a massive image collections?

**ARTIFACT CORRECTION**



**GRAPHIC REPRESENTATION**

Avoid artifacts and misalignments between photographs and the scene?

UNCERTAINTY

RADIOMETRY

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

# DISTORTION INTRODUCTION

## VISUALIZATION OF A SINGLE IMAGE



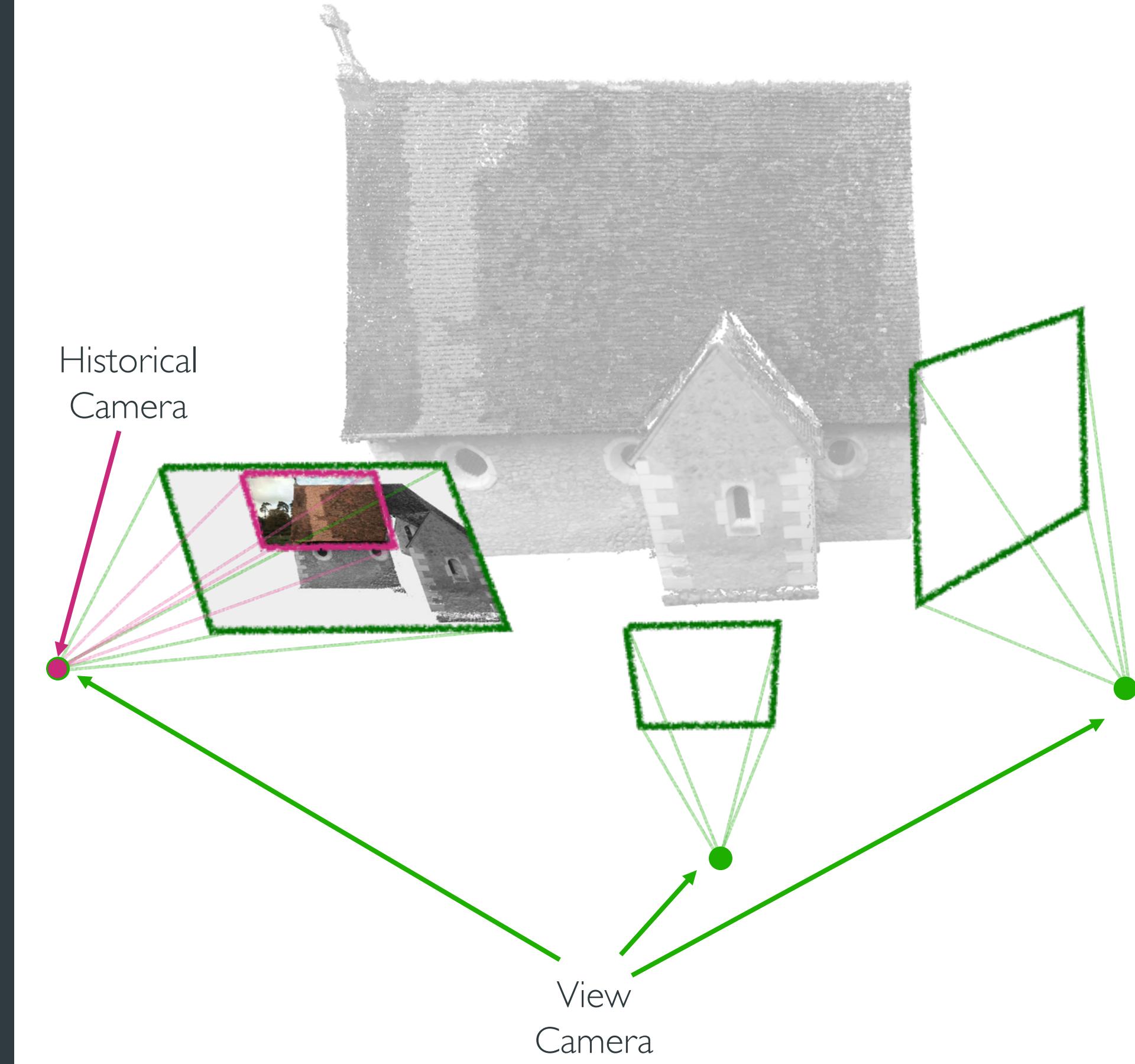
Pinhole Camera Model

View Camera

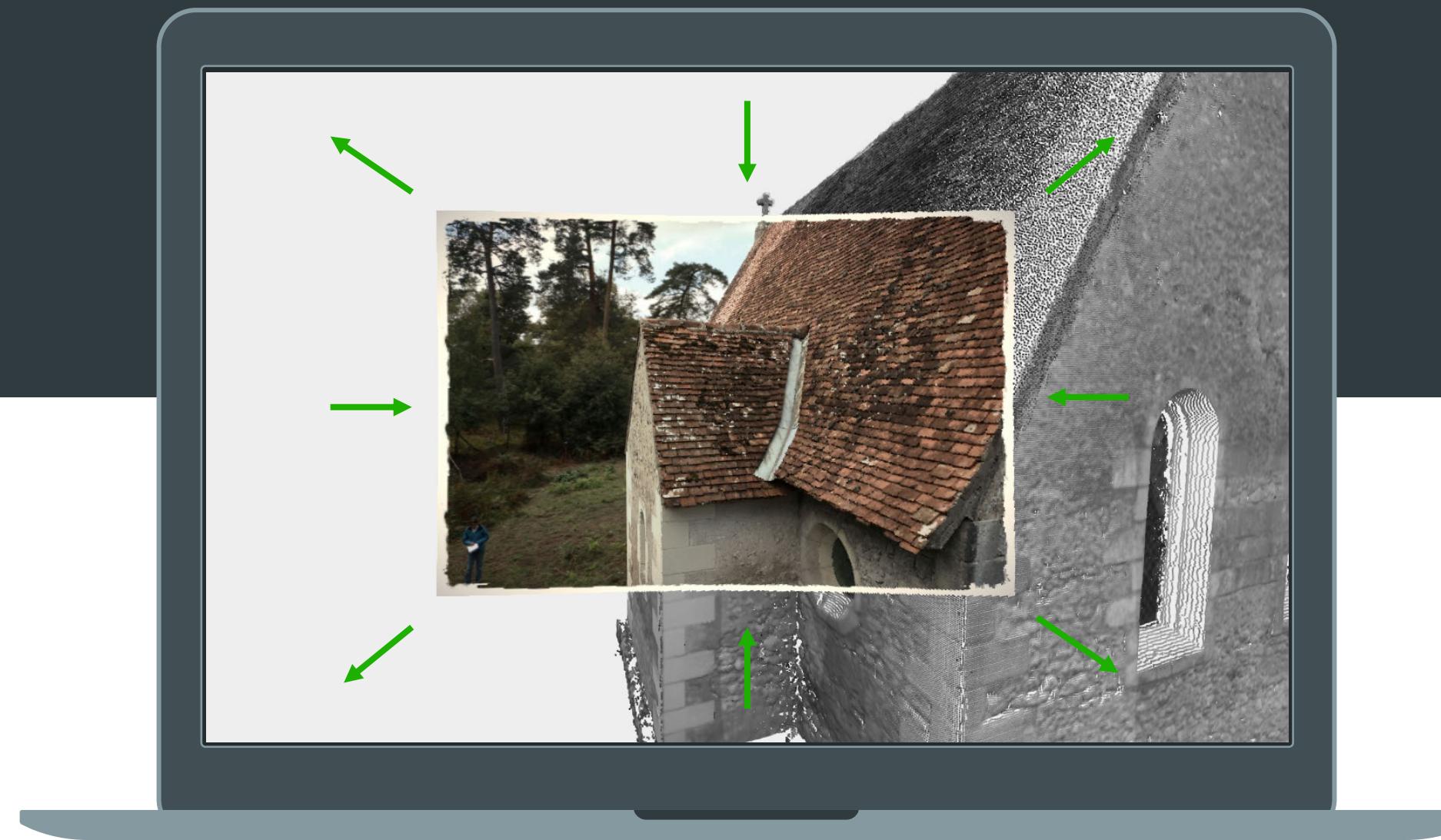


Historical Camera

Distorted Camera  
Model



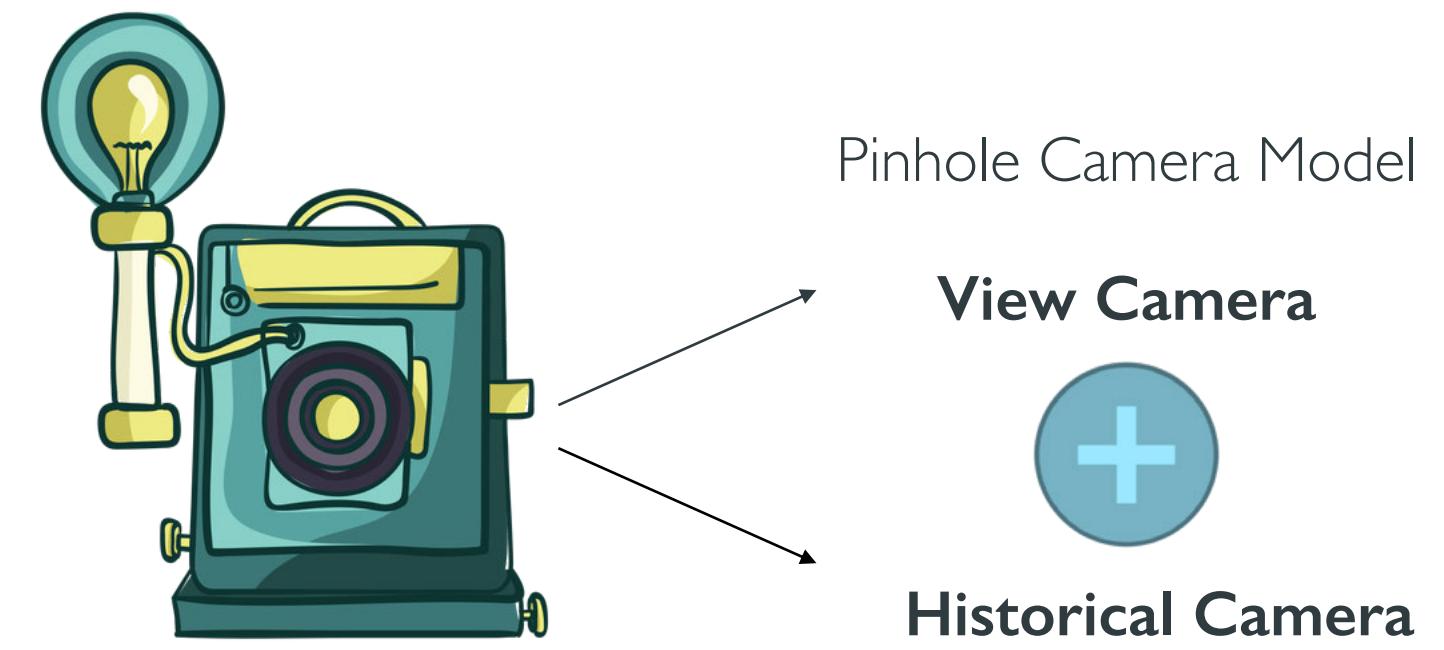
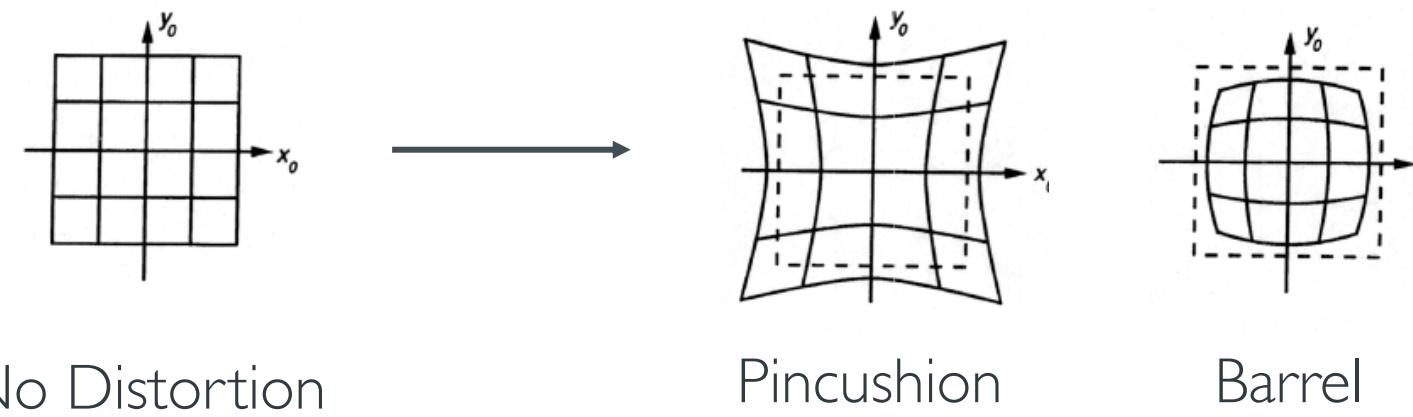
# DISTORTION INTRODUCTION



## DISTORTION

A small change in our coordinates.

(i.e. related in this case to our optical lens).

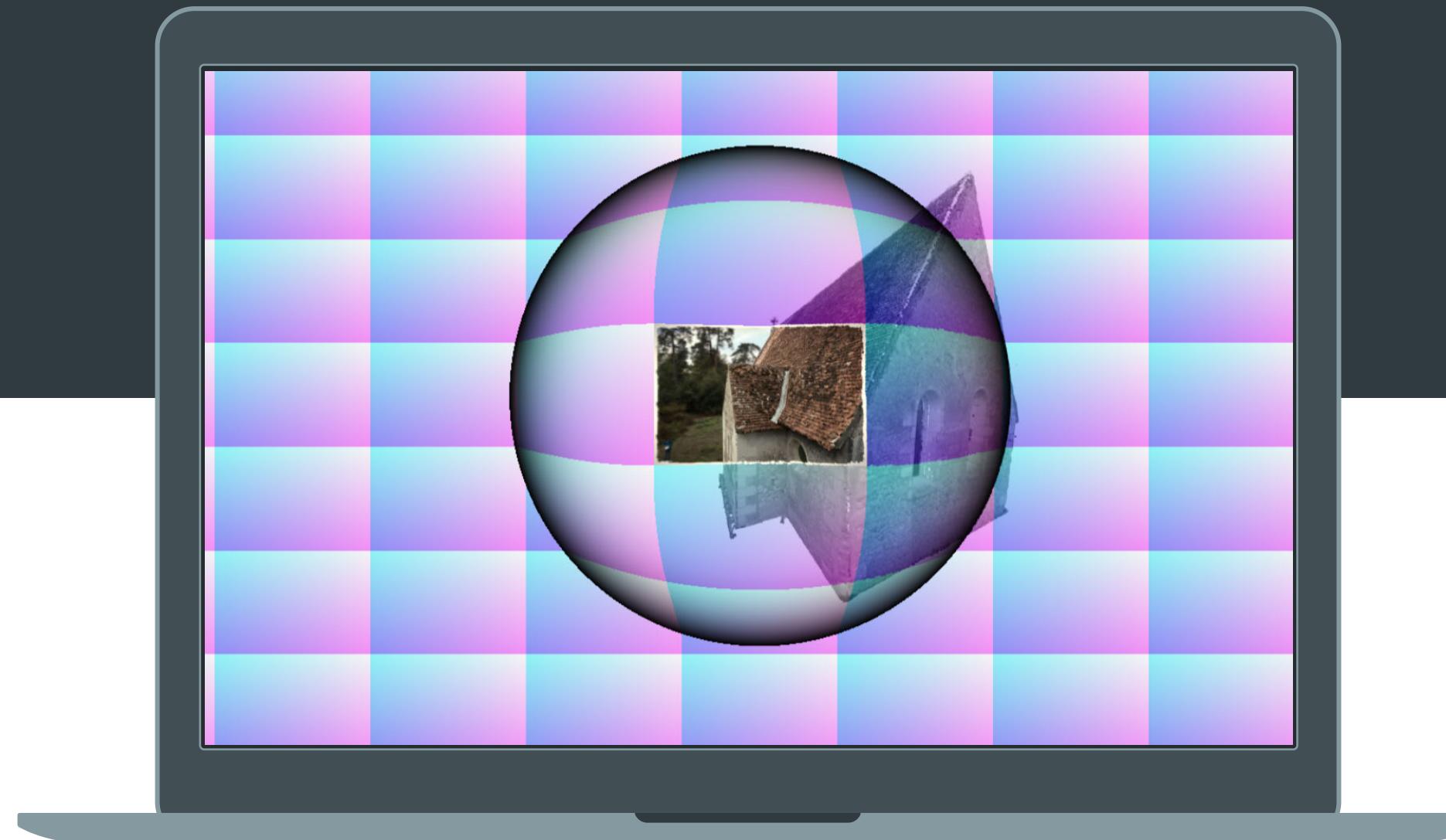


Historical Camera

Distorted Camera Model

Image Based Rendering or Large Historical Image Collection

# DISTORTION INTRODUCTION



## DISTORTION

A small change in our coordinates.

(i.e. related in this case to our optical lens).



Pinhole Camera Model

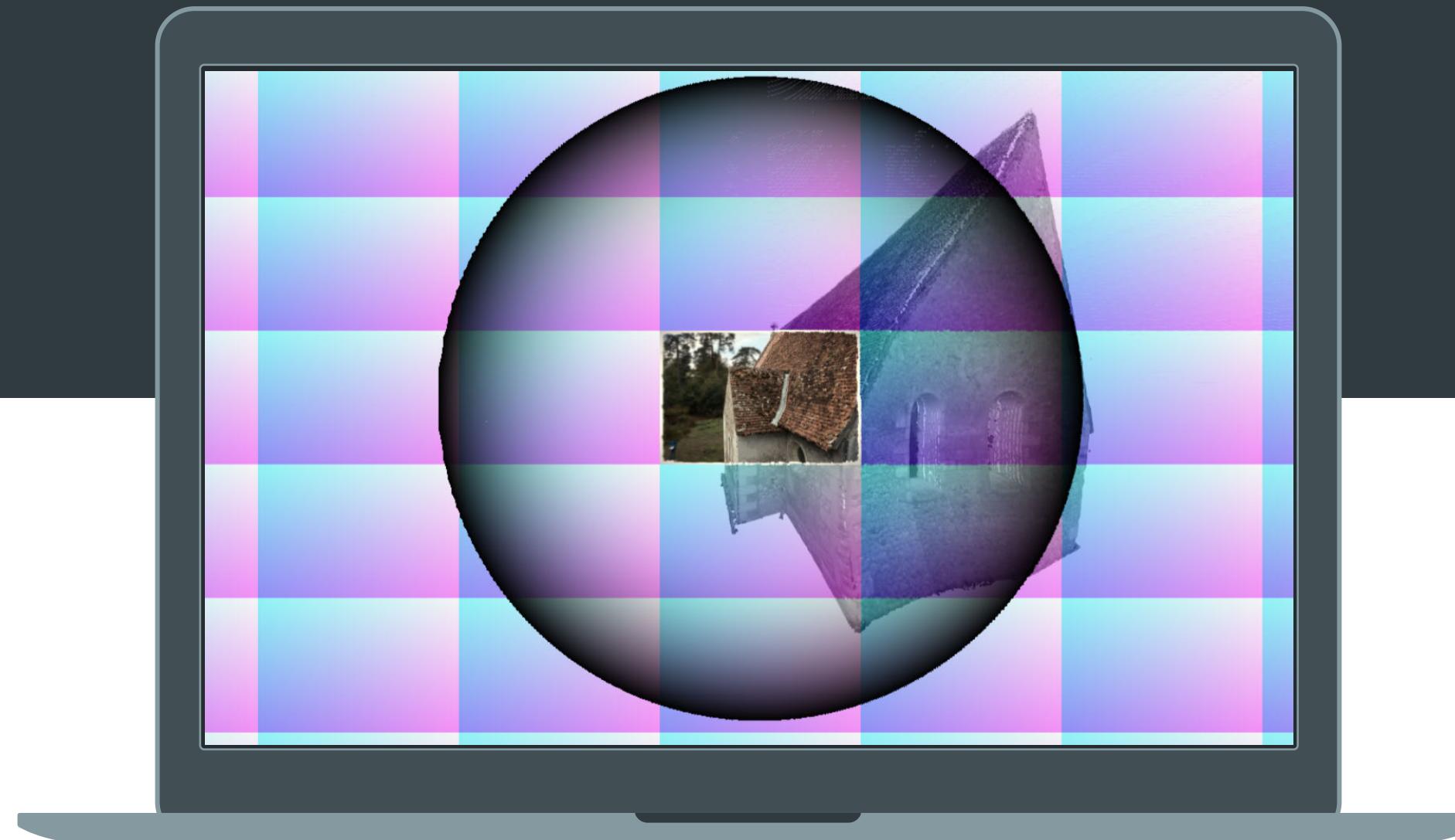
View Camera



Historical Camera

Distorted Camera  
Model

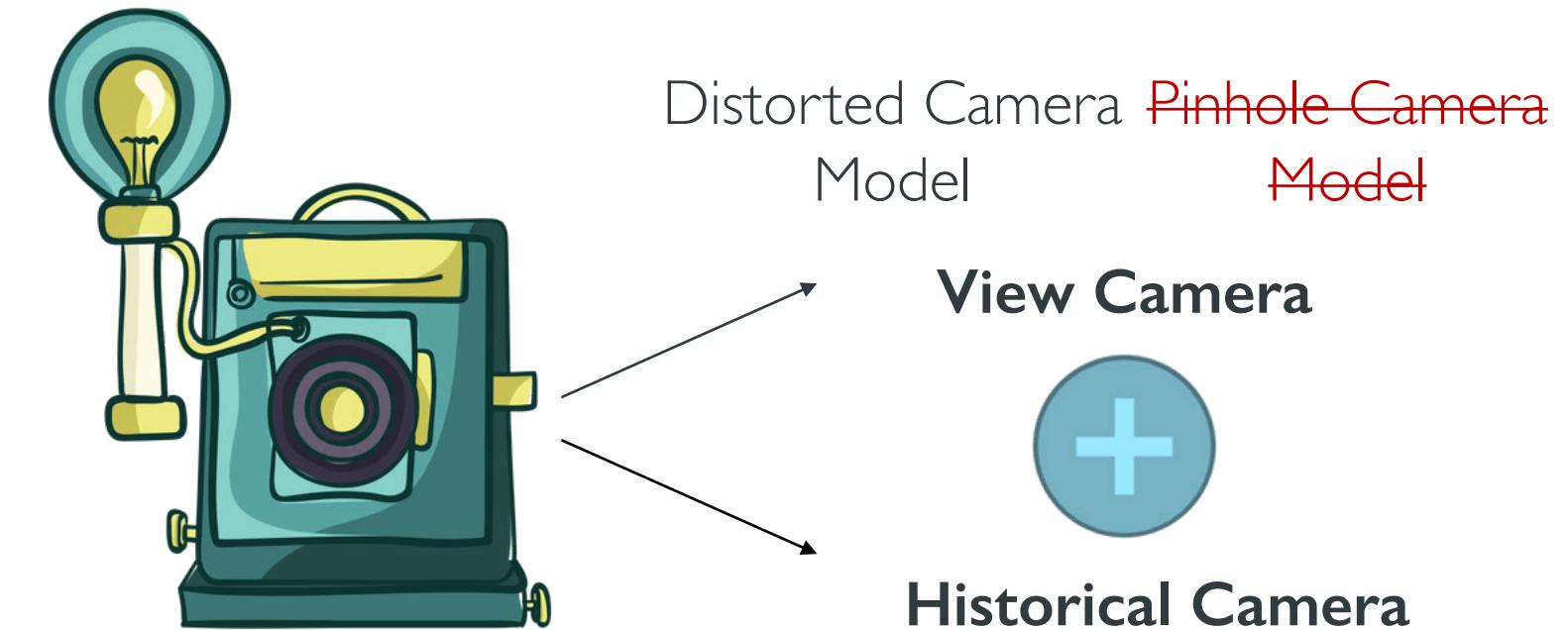
# DISTORTION INTRODUCTION



## DISTORTION

A small change in our coordinates.

(i.e. related in this case to our optical lens).



Distorted Camera ~~Pinhole Camera~~  
Model

**View Camera**

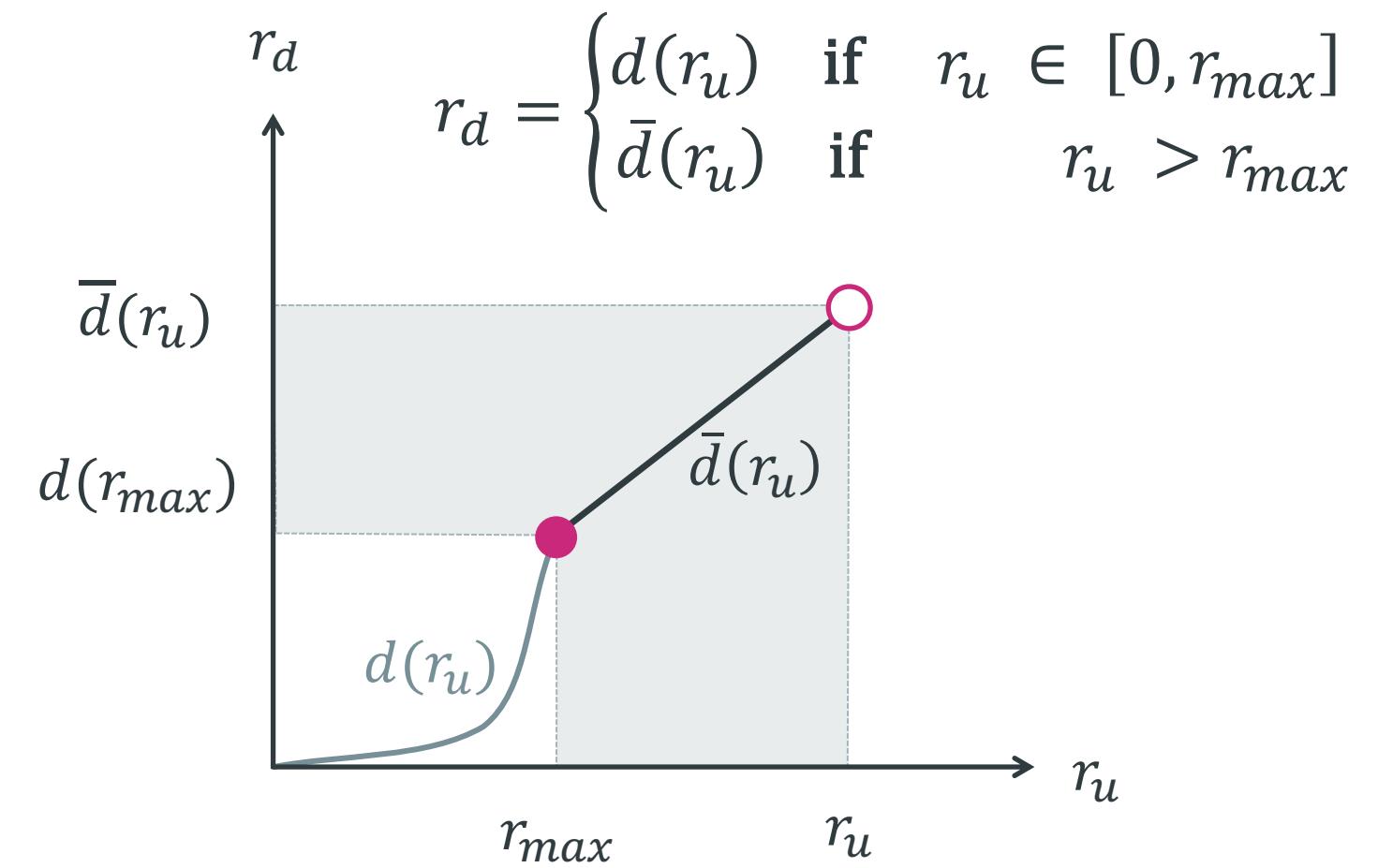
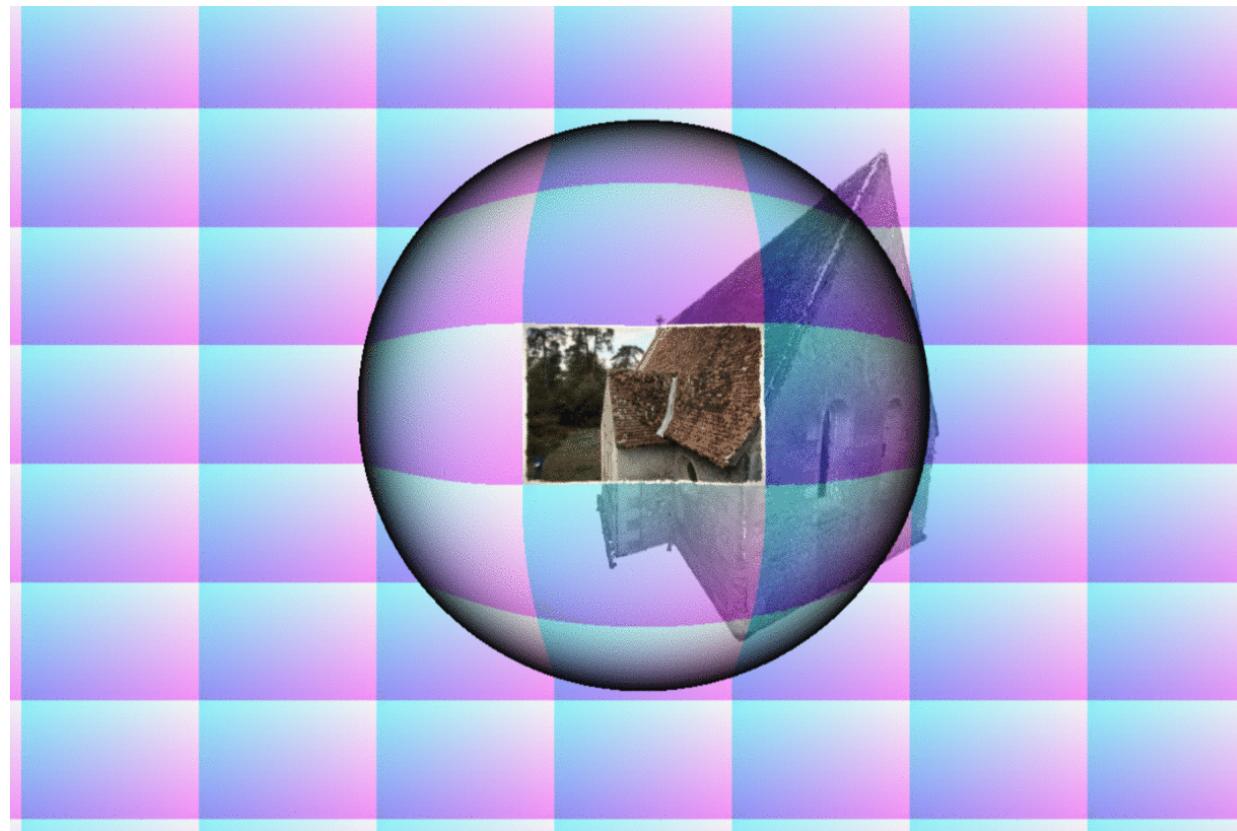


**Historical Camera**

Distorted Camera  
Model

# DISTORTION OBJECTIVE

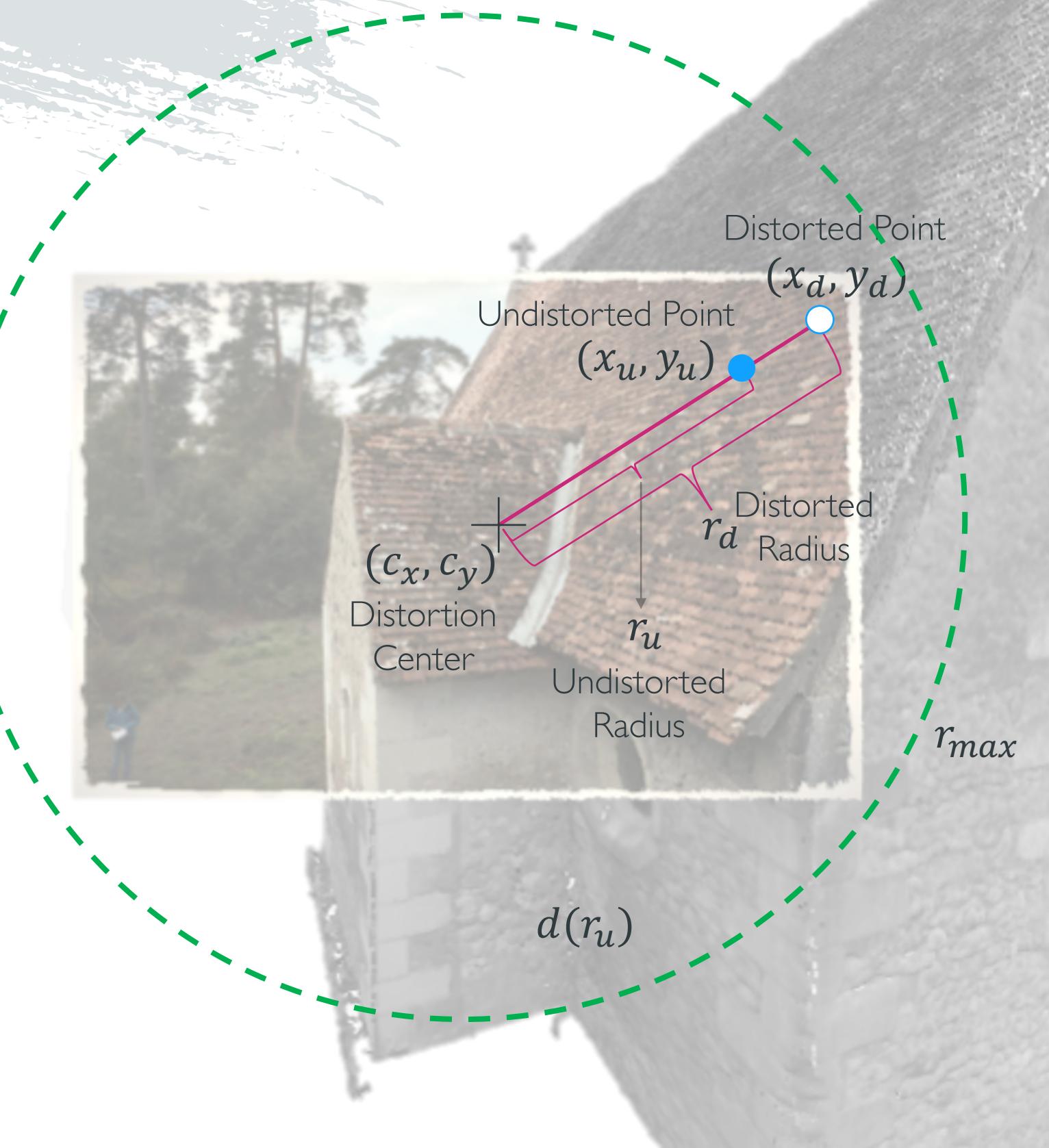
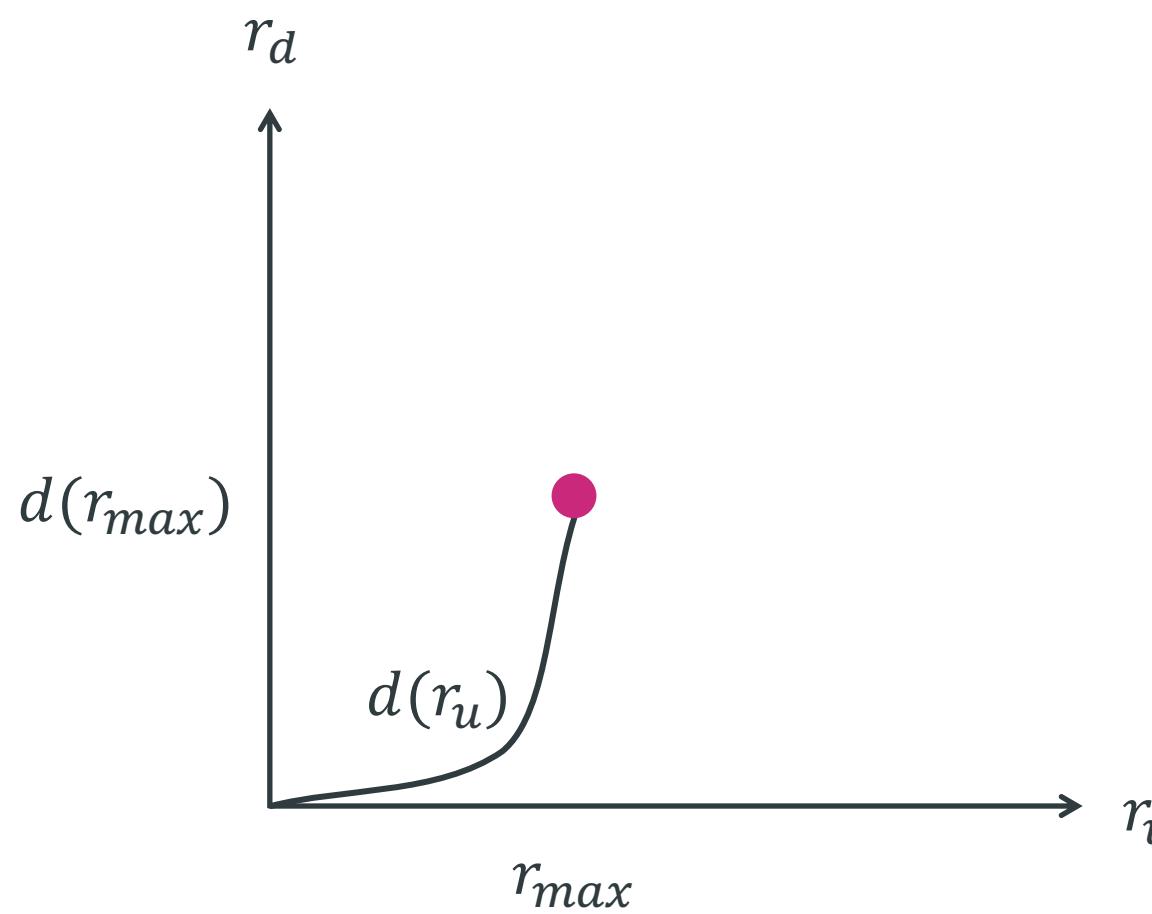
A continuous distortion function that can be used in both historical and view cameras.



# DISTORTION METHOD

## FUNCTION DEFINITION

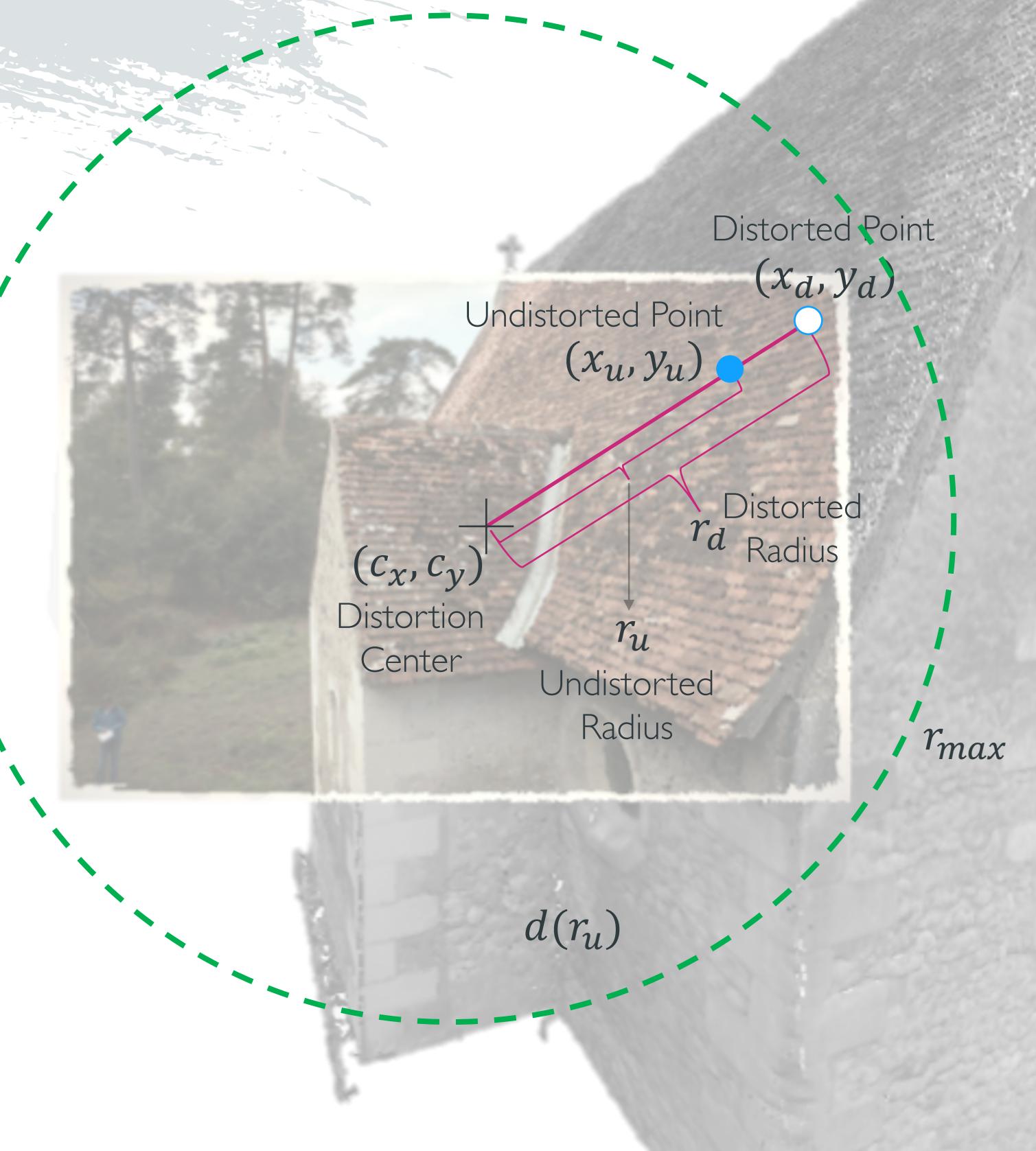
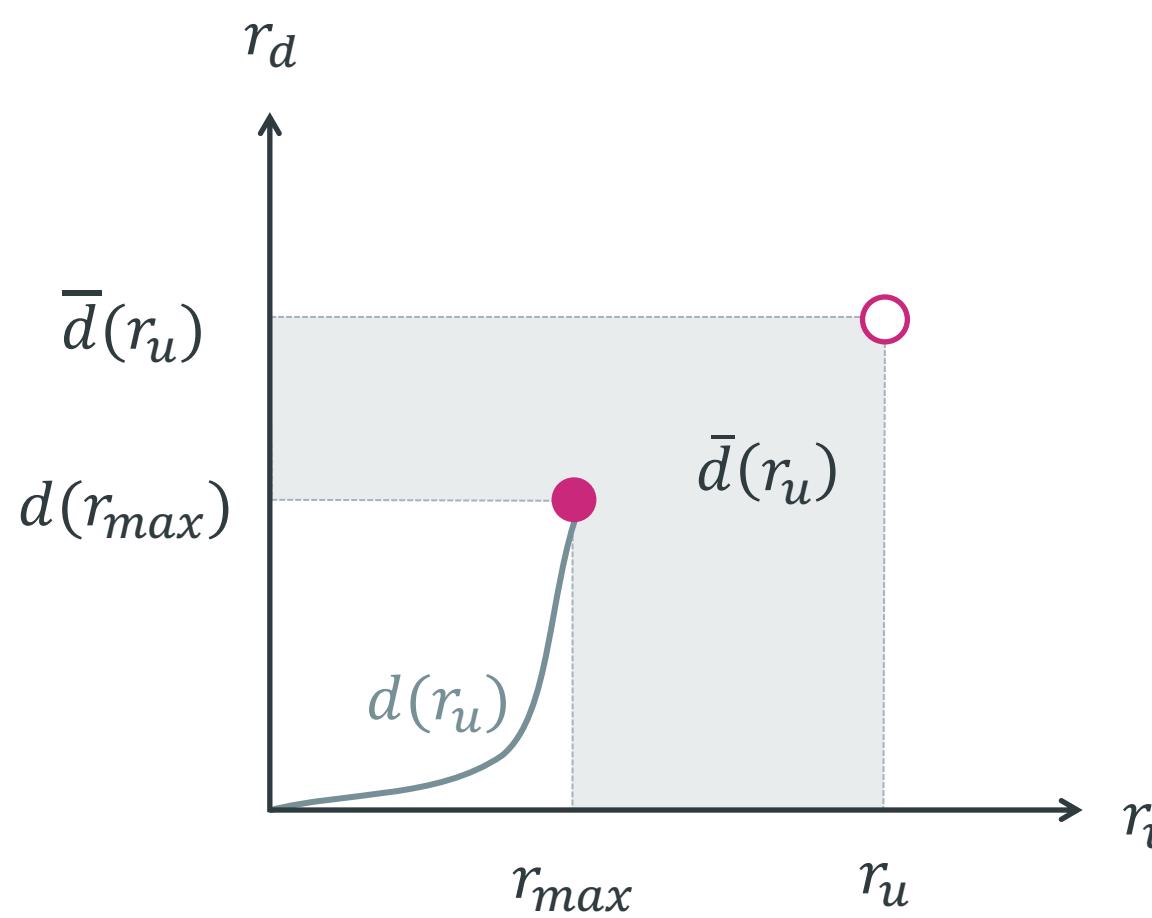
$$r_d = \begin{cases} d(r_u) & \text{if } r_u \in [0, r_{max}] \\ \bar{d}(r_u) & \text{if } r_u > r_{max} \end{cases}$$



# DISTORTION METHOD

## FUNCTION DEFINITION

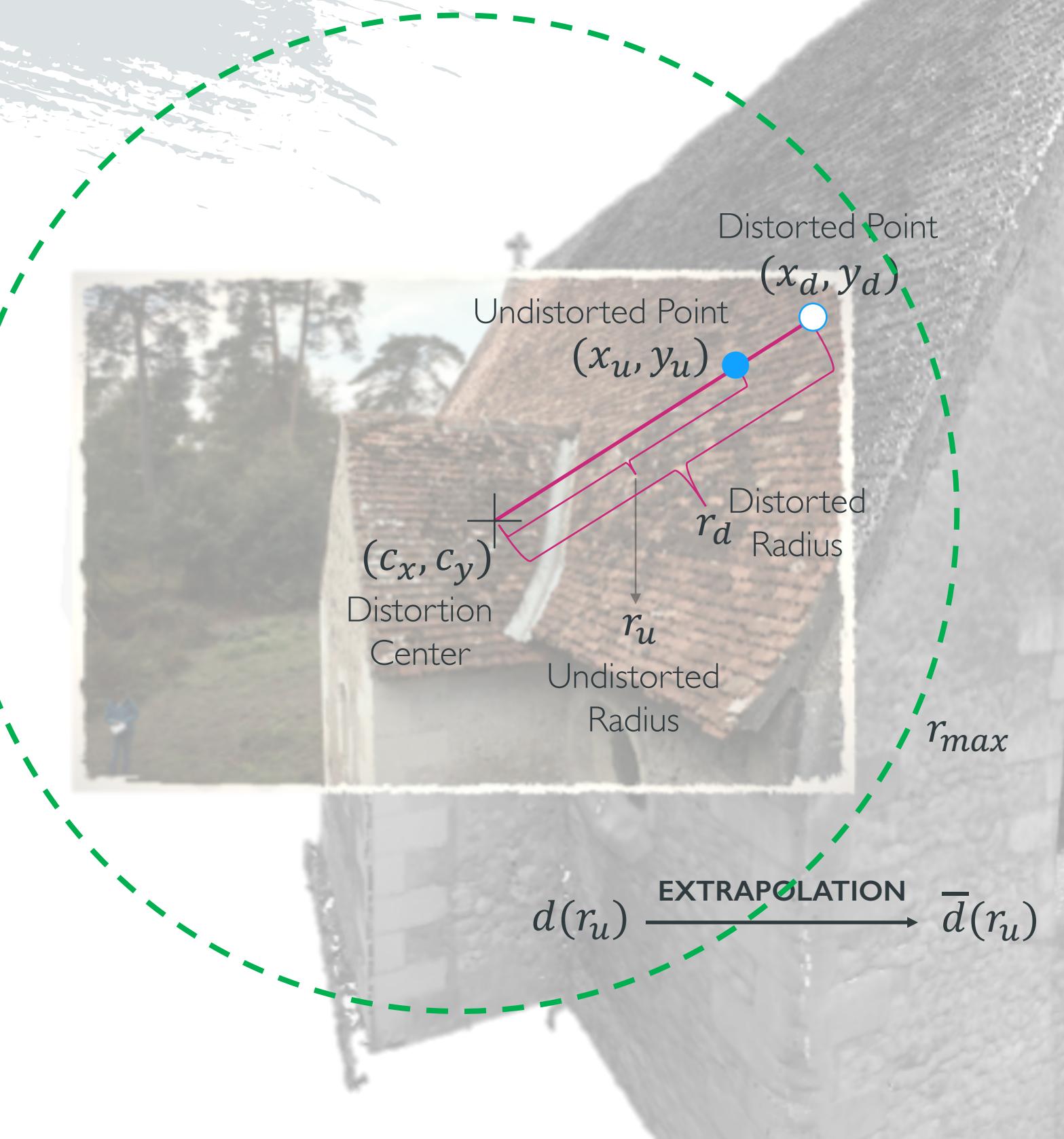
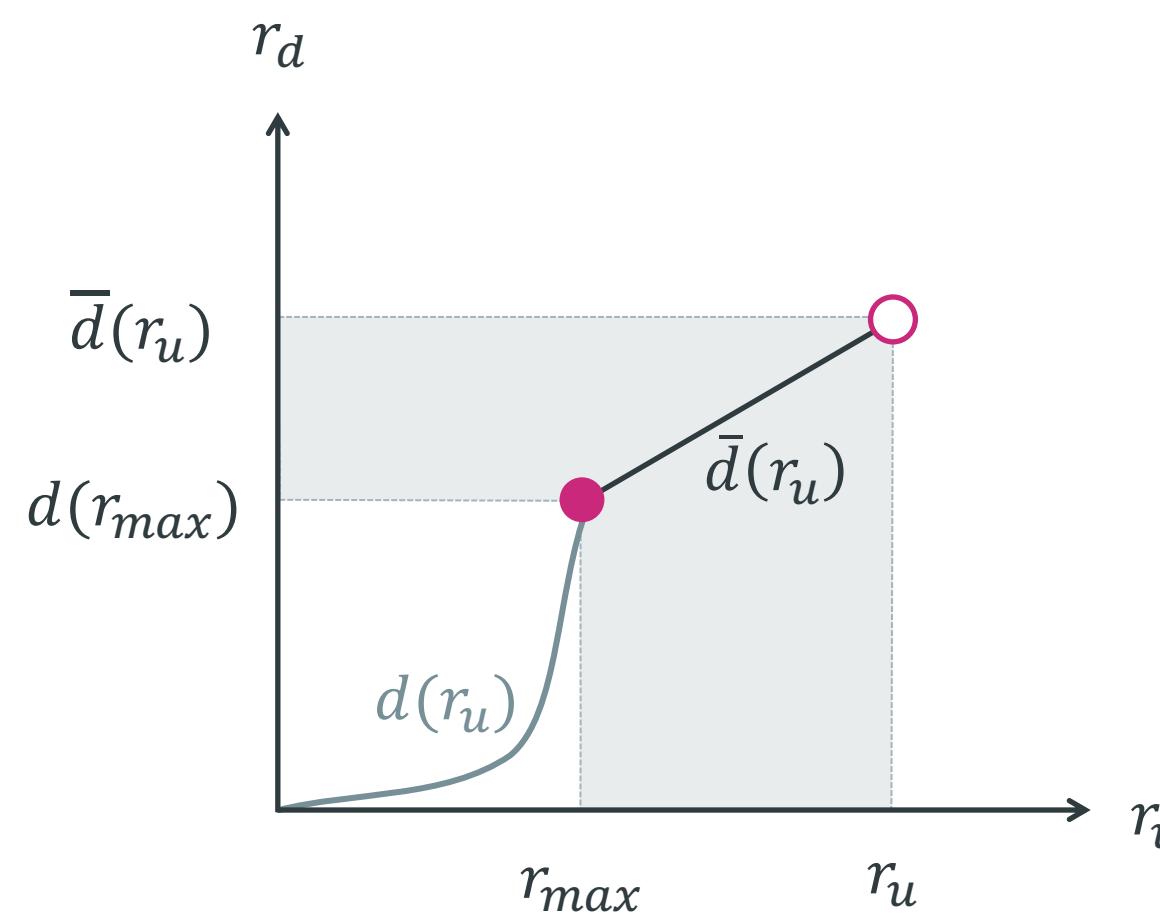
$$r_d = \begin{cases} d(r_u) & \text{if } r_u \in [0, r_{max}] \\ \bar{d}(r_u) & \text{if } r_u > r_{max} \end{cases}$$



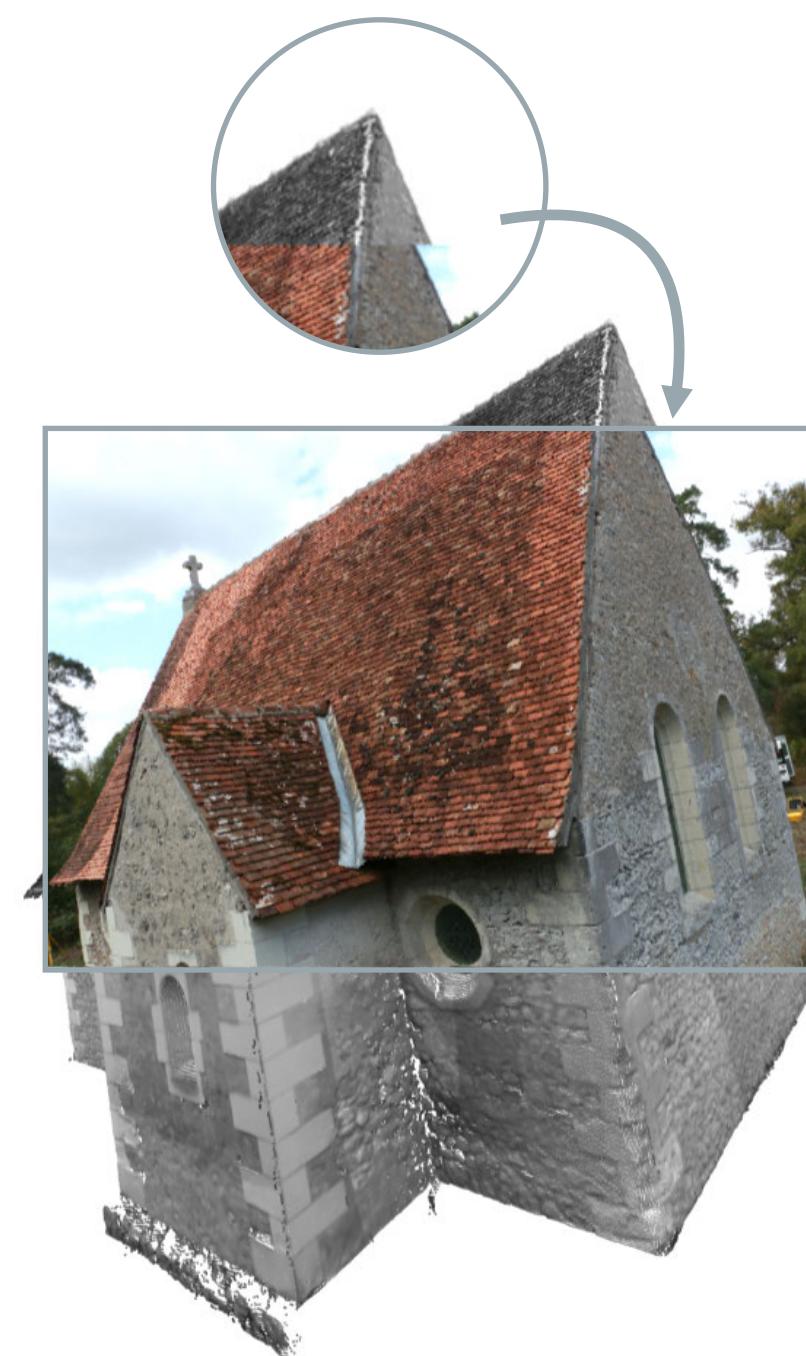
# DISTORTION METHOD

## FUNCTION DEFINITION

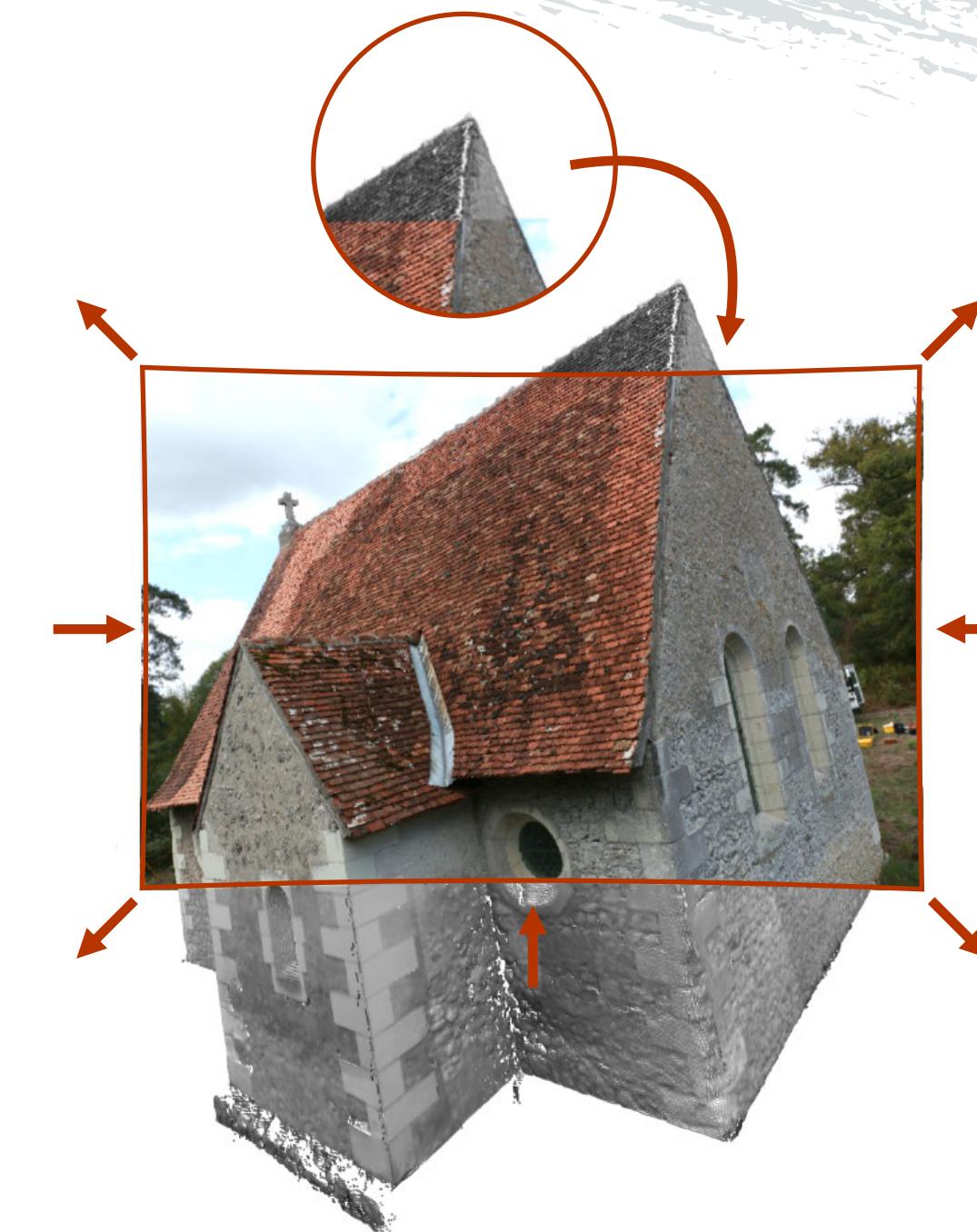
$$r_d = \begin{cases} d(r_u) & \text{if } r_u \in [0, r_{max}] \\ \bar{d}(r_u) & \text{if } r_u > r_{max} \end{cases}$$



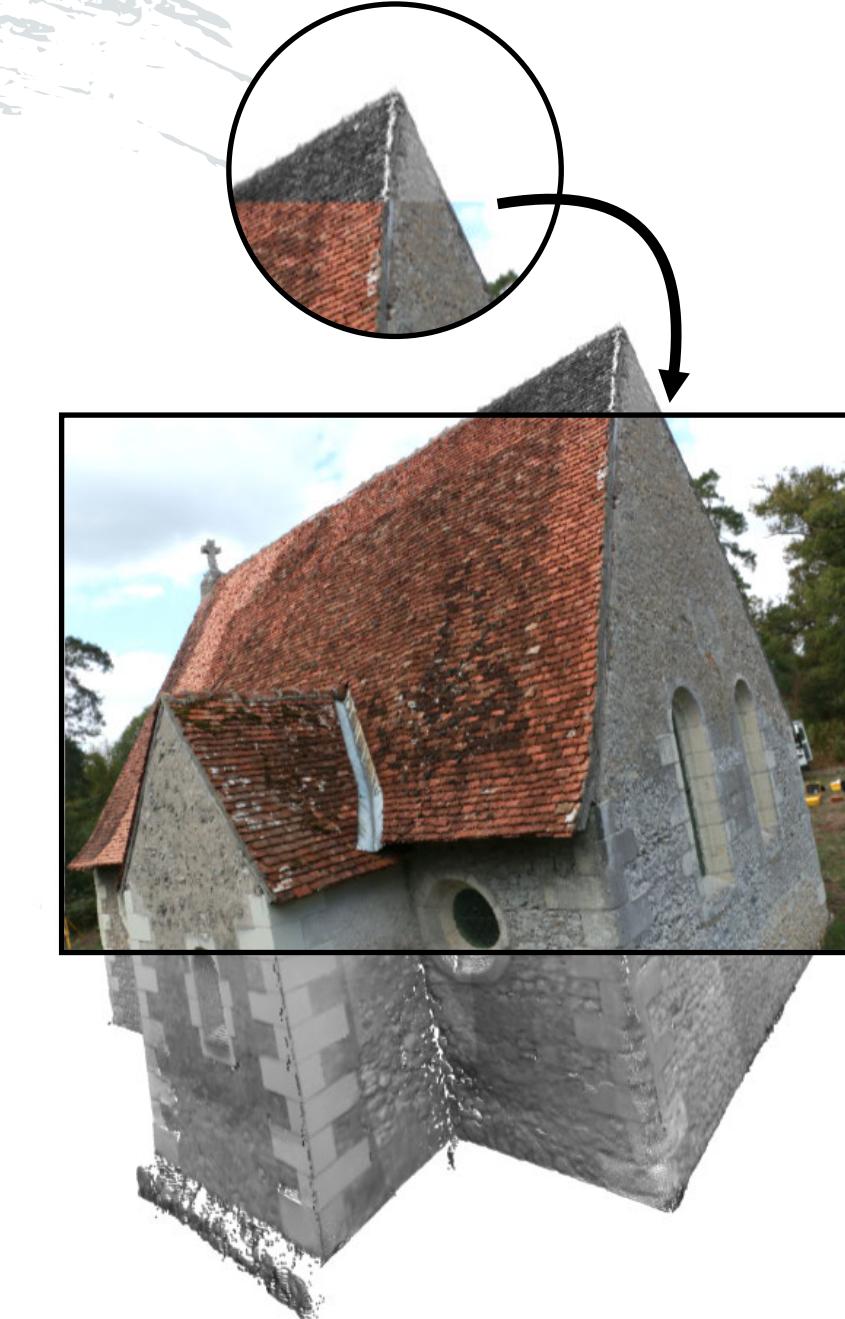
# DISTORTION RESULT



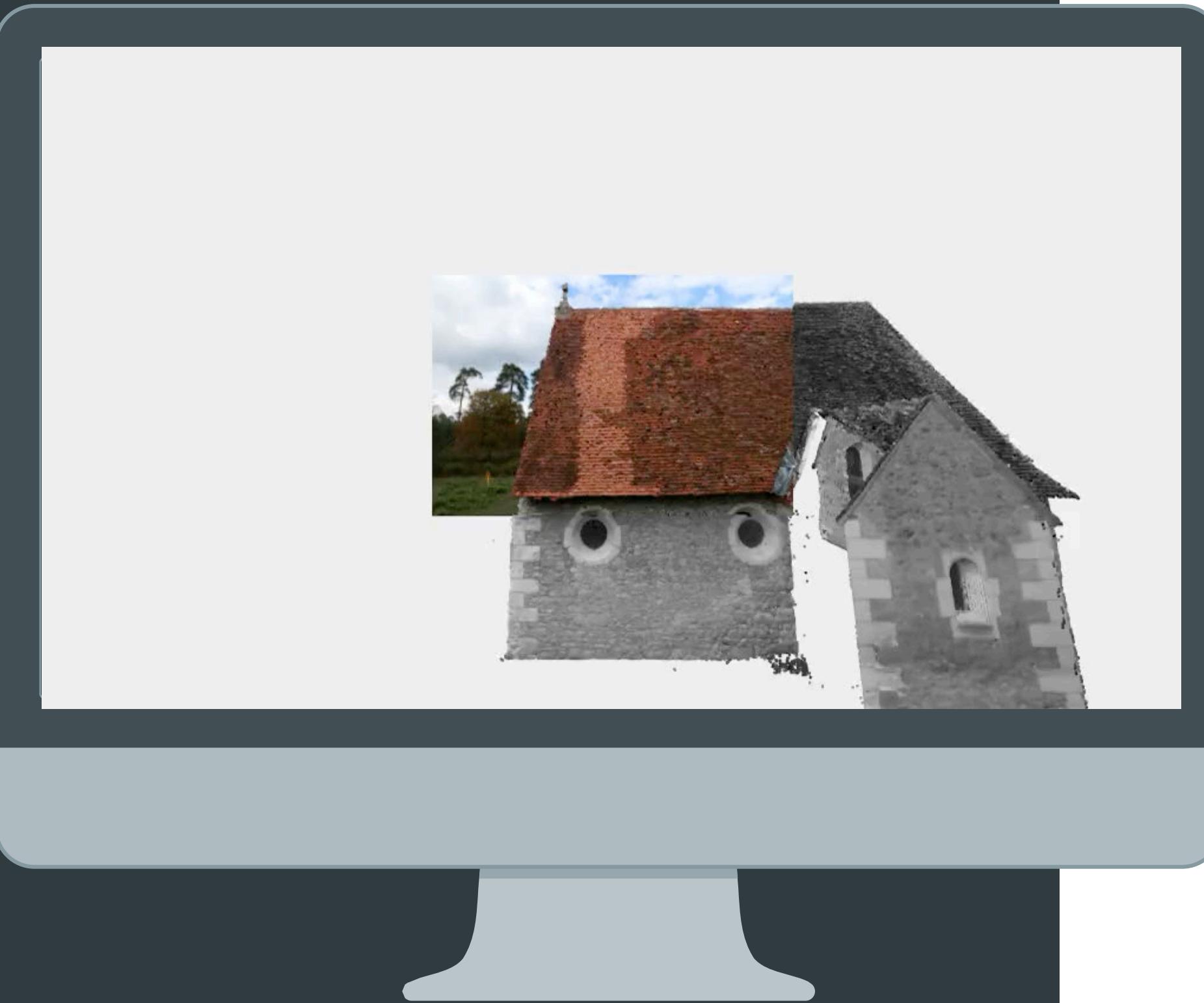
View Camera: Pinhole model  
Historical Camera: Pinhole model



View Camera: Pinhole model  
Historical Camera: Distorted model



View Camera: Distorted model  
Historical Camera: Distorted model



# DISTORTION RESULT

---

# THANK YOU!

## ANY QUESTIONS?

### Contact

Evelyn Paiz Reyes [evelyn.paiz-reyes@ign.fr](mailto:evelyn.paiz-reyes@ign.fr)

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

