



AUBURN UNIVERSITY, USA
McWhorter School of Building Science

A Framework for Digital Documentation and Virtual Reconstruction of Cultural Heritage

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ICCT 2026

October 30, 2026, Shanghai, China

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About the presenter



Research focus

Reality capture technology, LiDAR scanning, photogrammetry, 360° virtual tours, and HBIM

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100+

Peer-reviewed
publications

50+

Keynotes, presentations,
and workshops

\$3M

Grants and contracts

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Digital Heritage Documentation & Reconstruction Technology

- LiDAR
- Photogrammetry
- 360° Photography – Virtual Experience
- Heritage Building Information Modeling (HBIM)

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LiDAR Scanning

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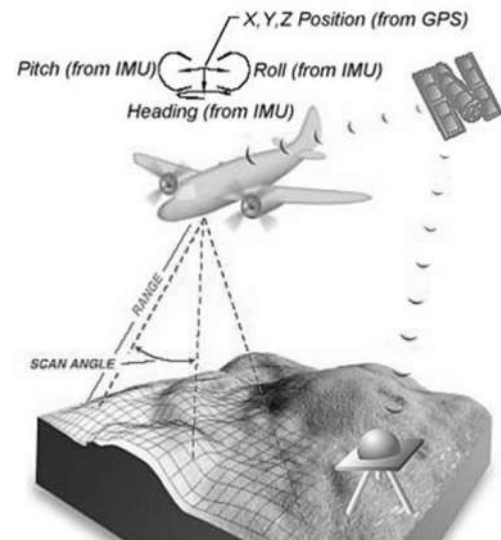
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LiDAR Technology

LiDAR = Light + Detection And Ranging

A remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light

How a Laser Scanner Works?

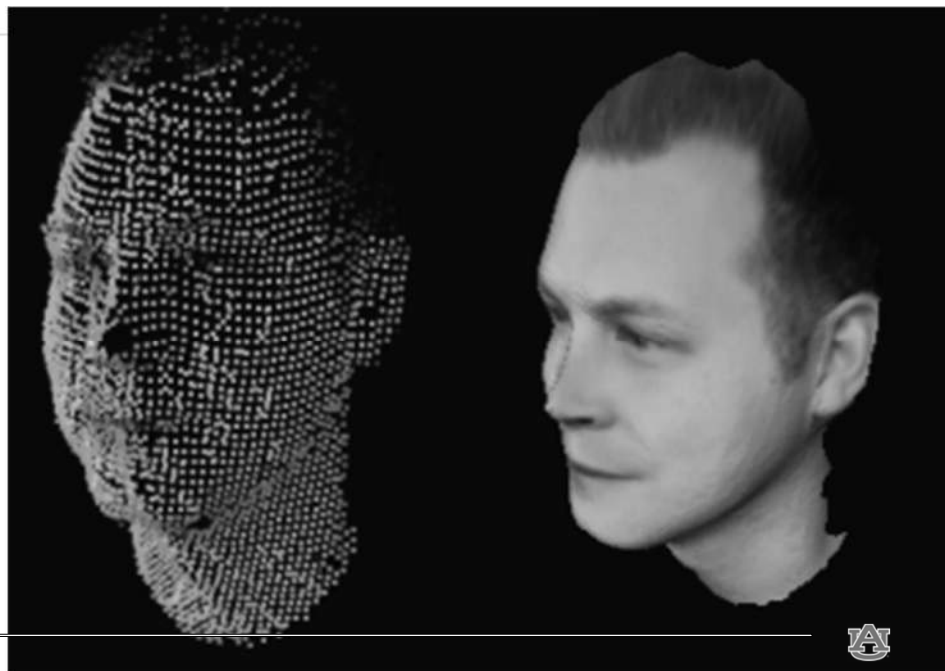


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3D Point Cloud



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Leica ScanStation C10



Faro Focus3D X-130 HDR

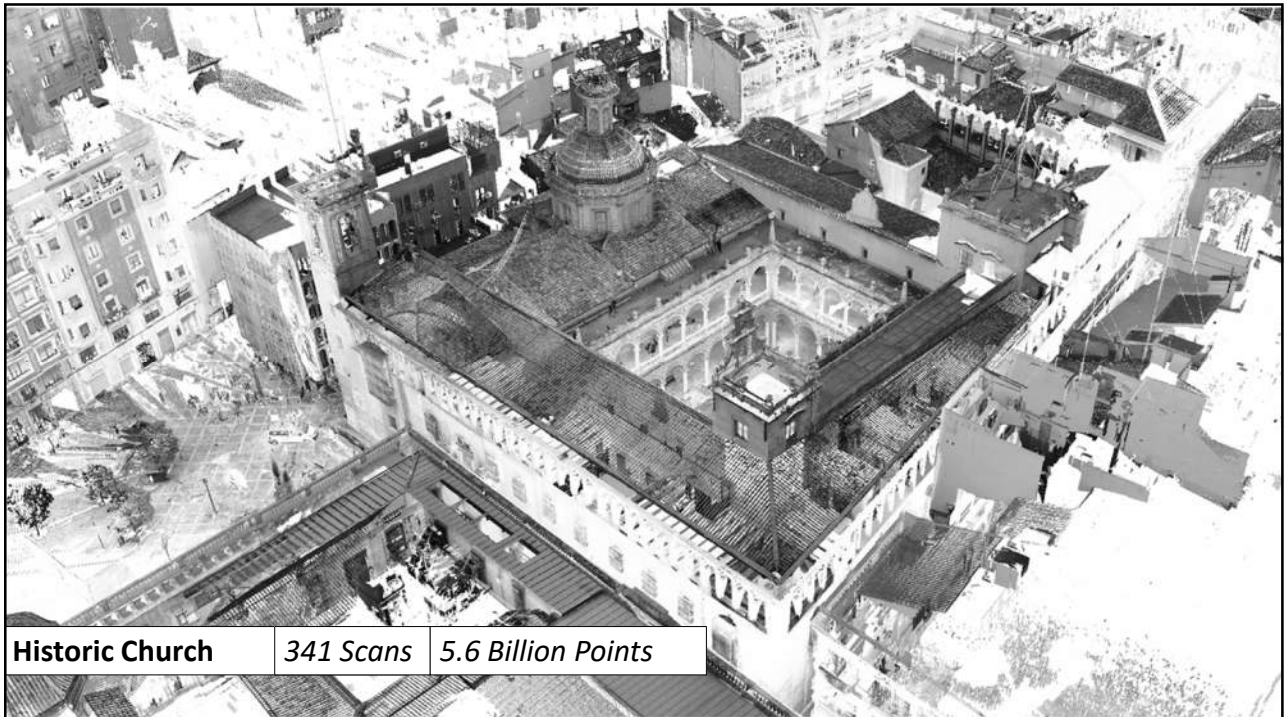


Faro Focus S-350 Plus

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Historic Church

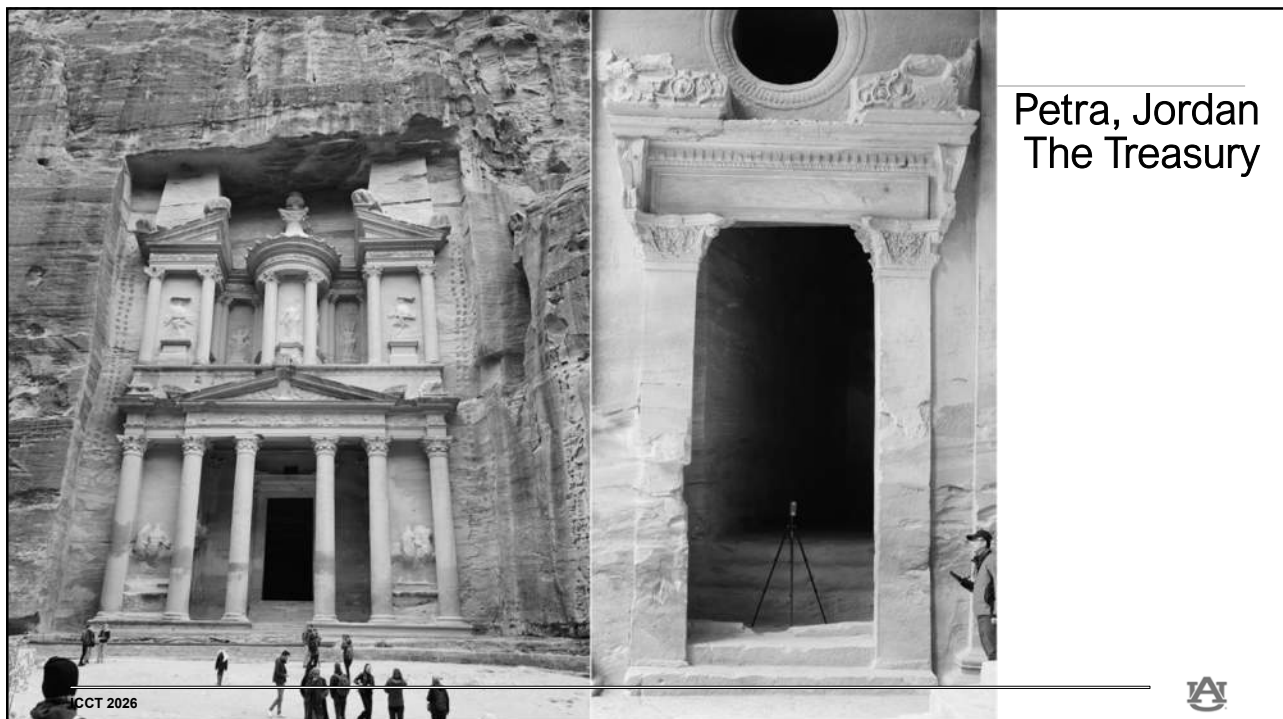
341 Scans

5.6 Billion Points

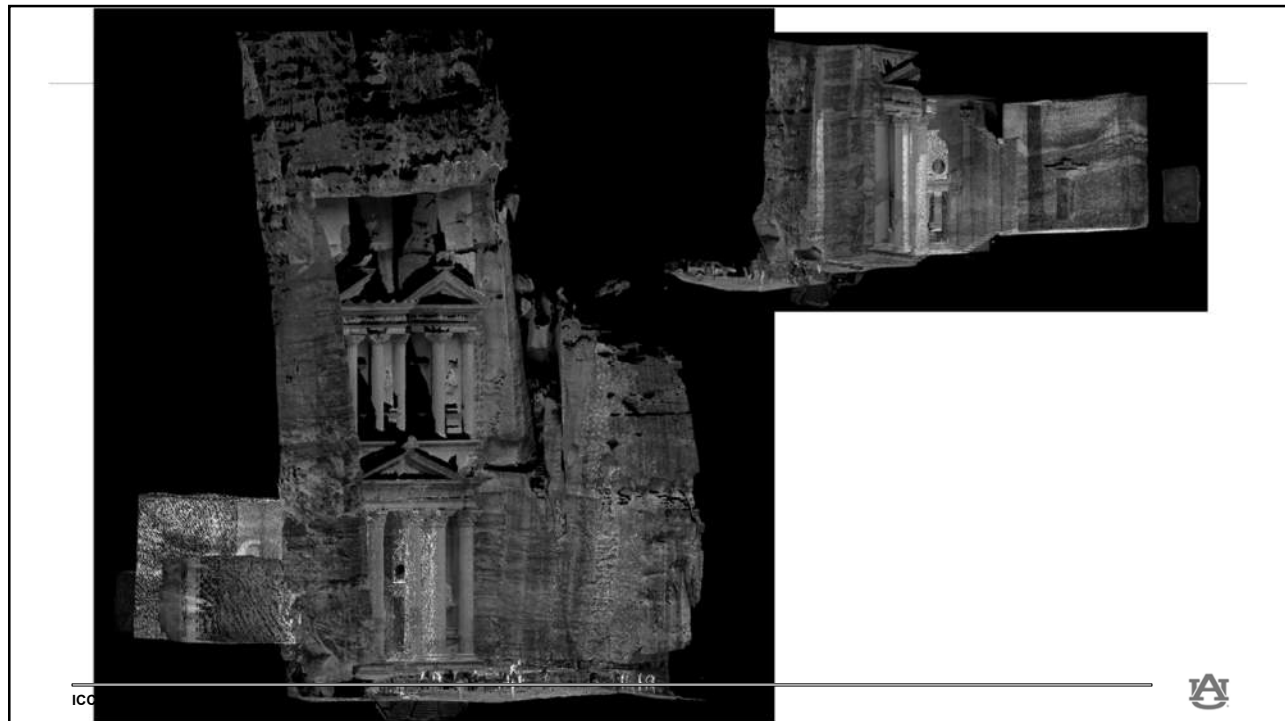
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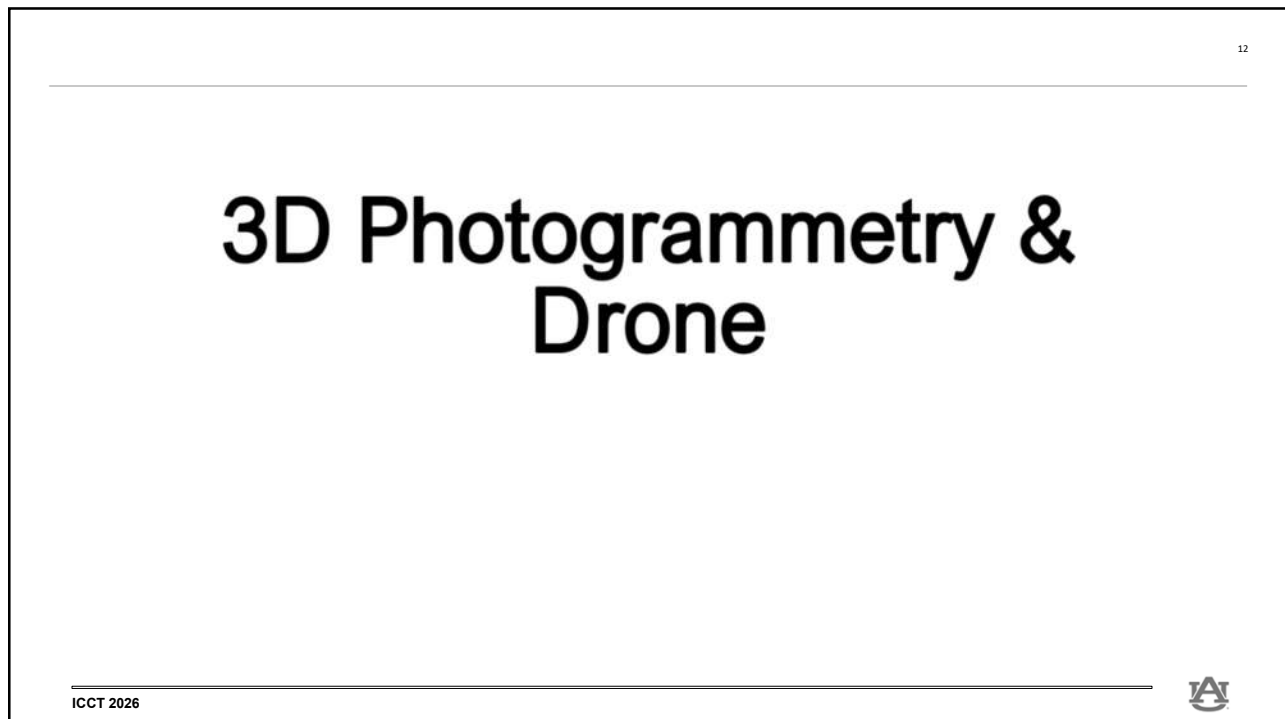
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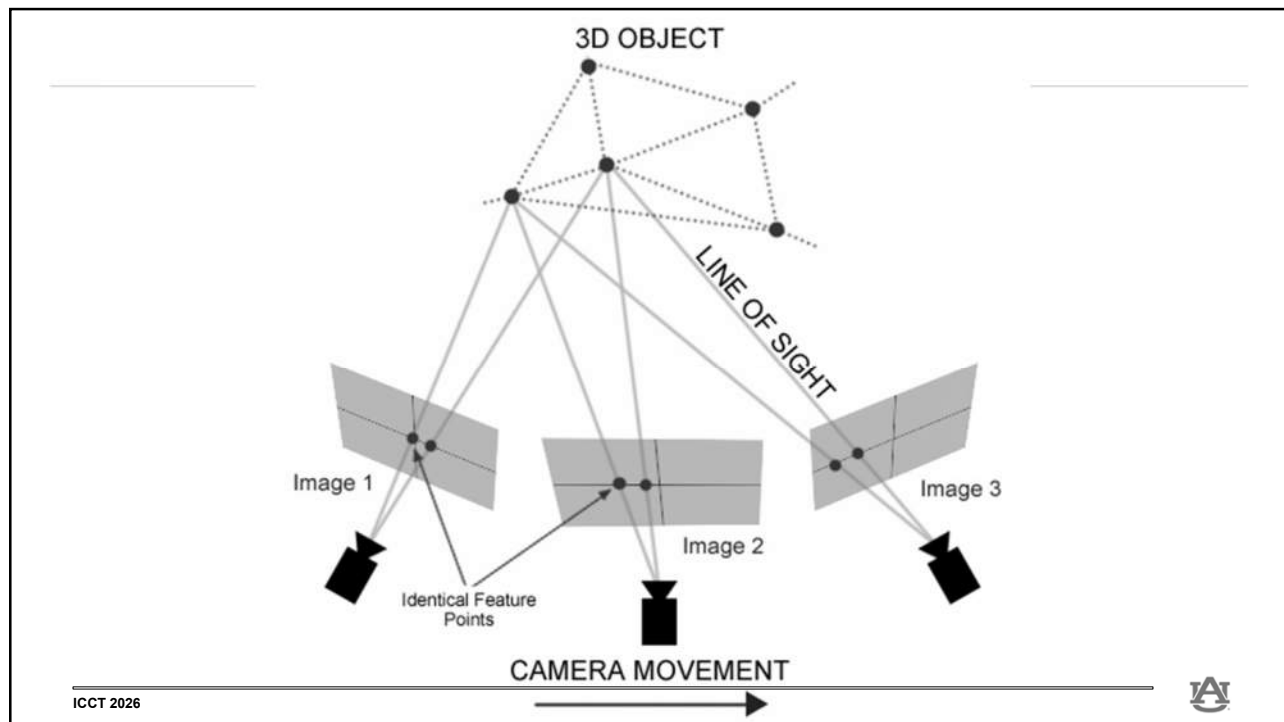
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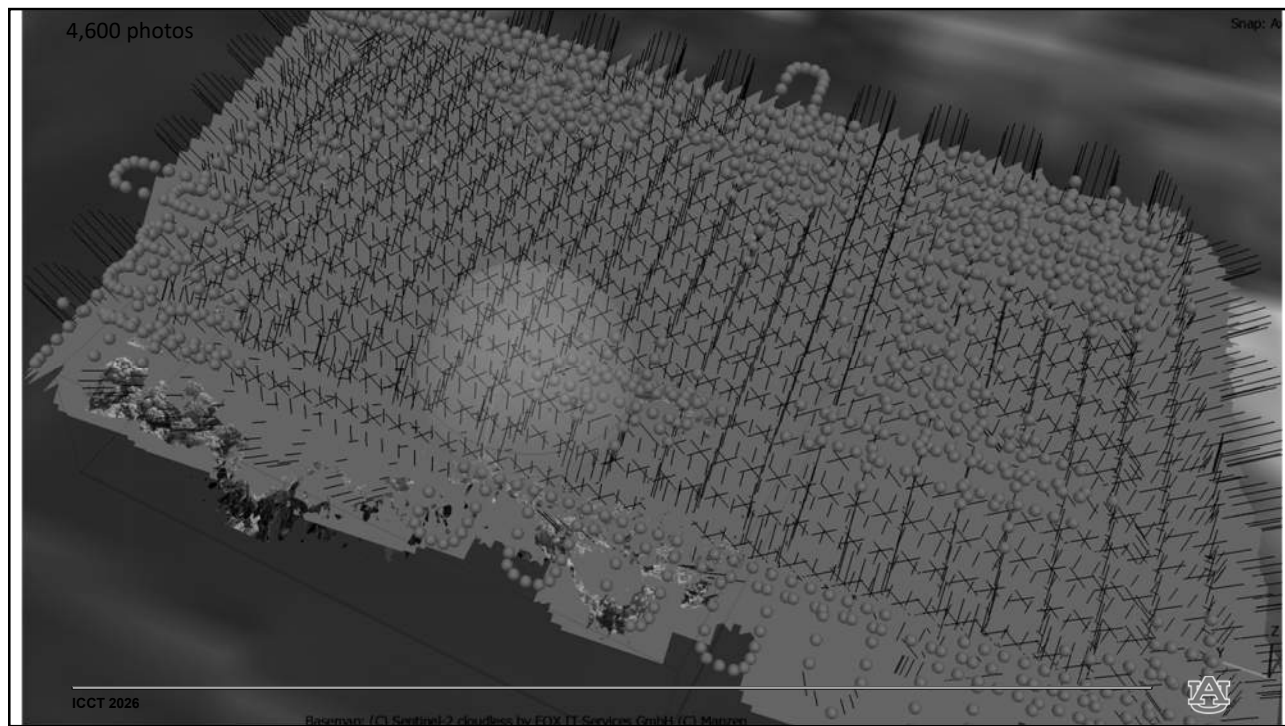
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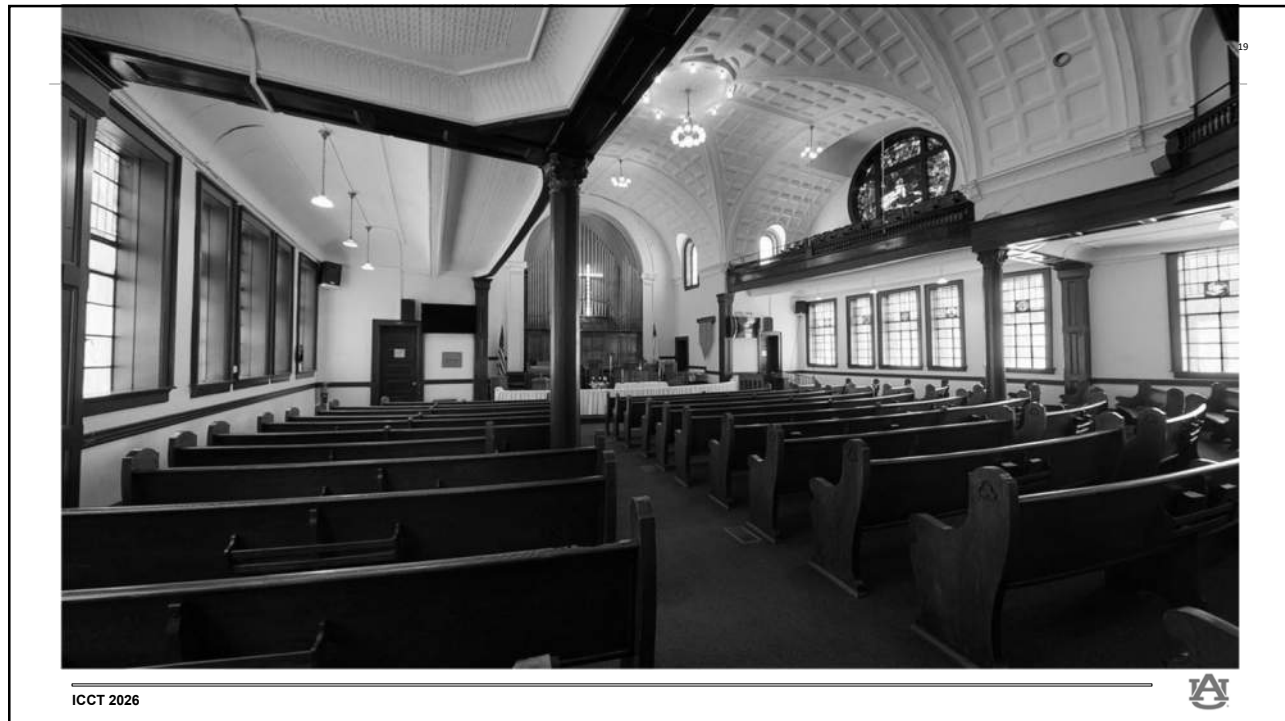
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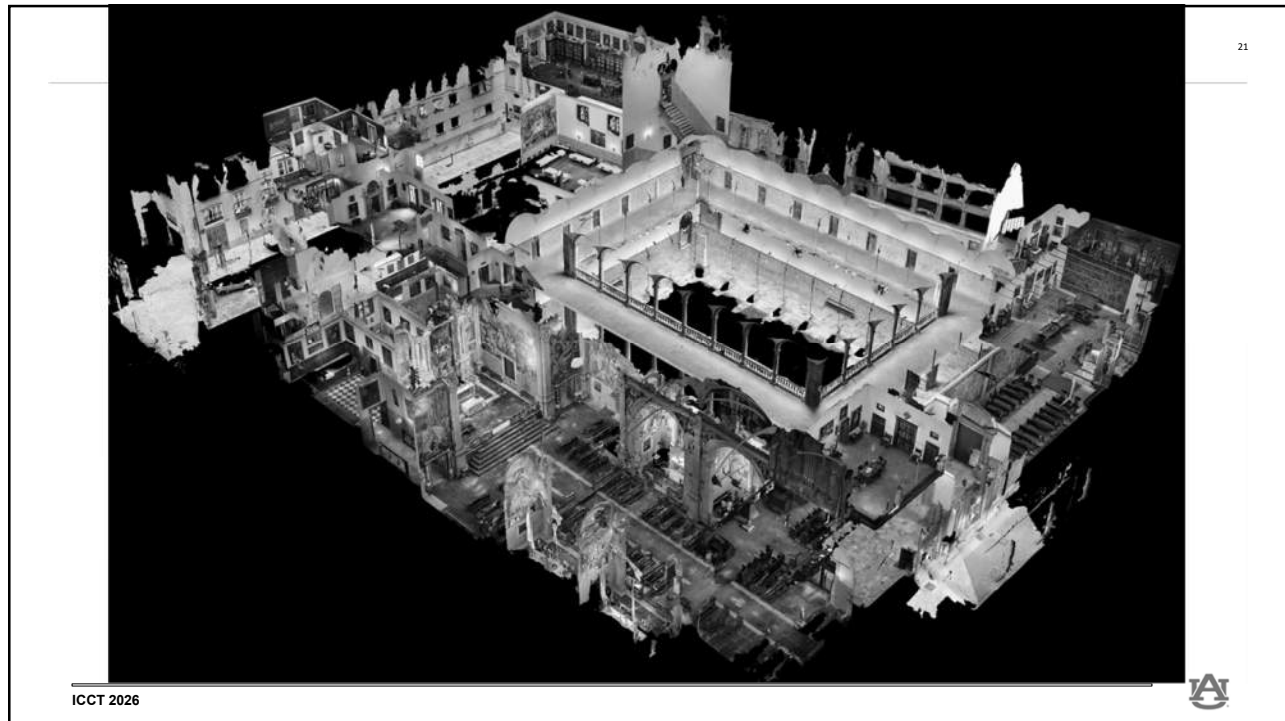


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Heritage BIM/HBIM

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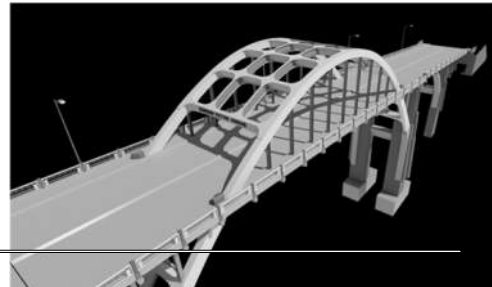
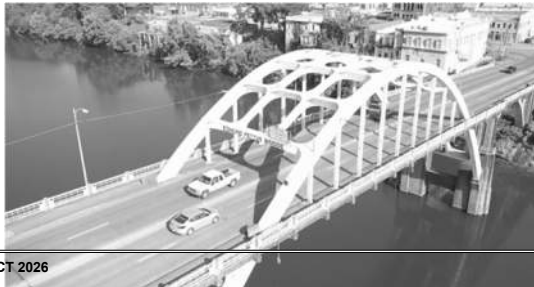
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What is HBIM?

Heritage/Historic Building Information Modeling

A process that produces intelligent BIM models containing and managing information of historic structures

An emerging technology that enables people to understand, document, advertise, and virtually reconstruct the built heritage



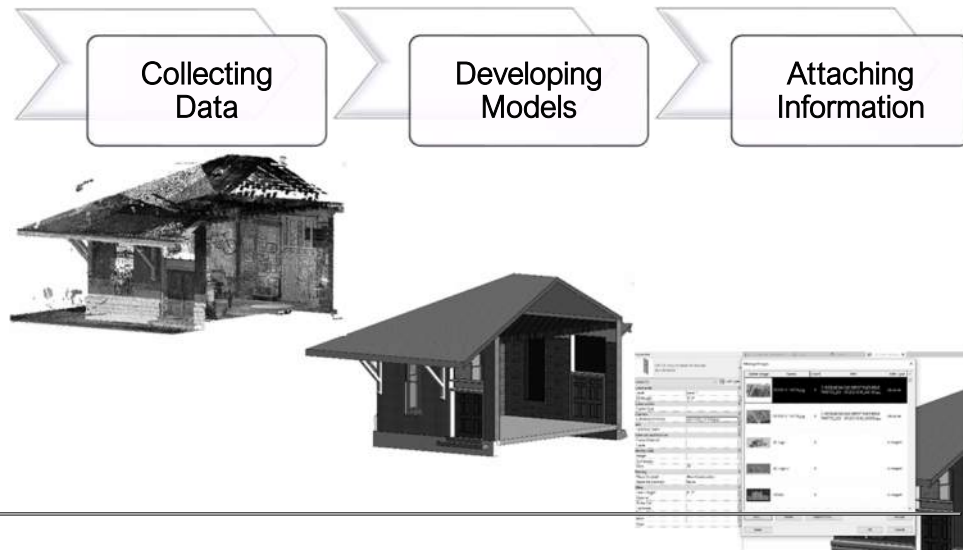
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How HBIM Works?



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Old Depot Museum, Selma, AL: - A Case Study of HBIM

Former L&N Railroad Depot

Built around 1890

Collections:

- Prehistoric American Indians
- Civil War, WW II, Korean War, Vietnam War
- Civil Rights Movement



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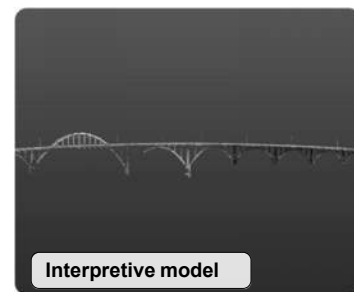
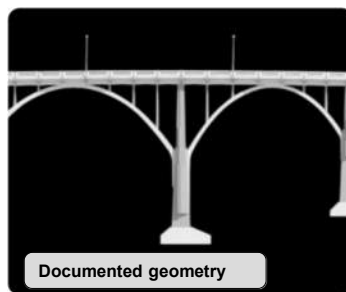
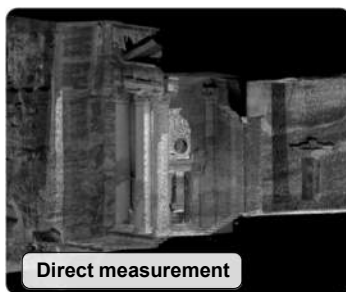


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Heritage condition changes the evidence base



As physical evidence decreases, digital reconstruction depends more heavily on historical interpretation.

A shared decision structure is needed to connect condition, evidence, method, and delivery.

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Research question

How should heritage condition and available evidence guide digital documentation, reconstruction, and delivery?

Qualitative synthesis of representative digital-heritage studies

01 Heritage condition

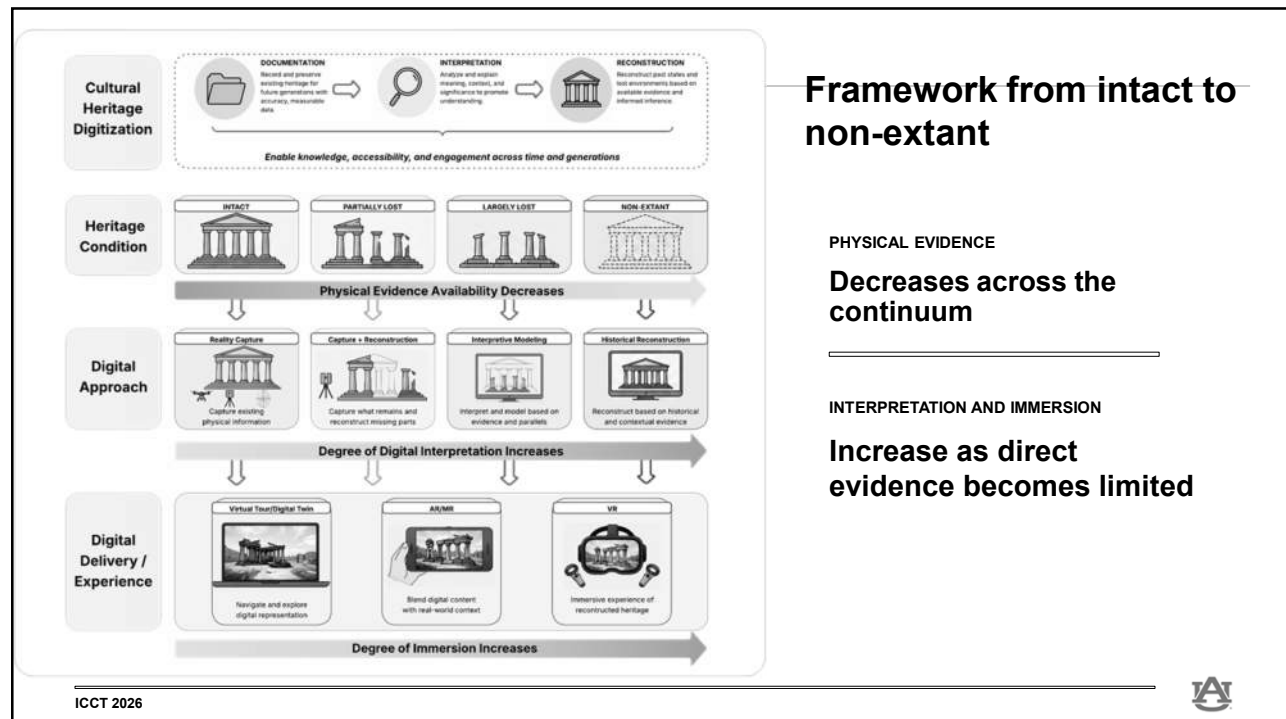
02 Digital approach

03 Digital delivery

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Measured fabric anchors reconstruction



Laser scanning and architectural survey provide the geometric foundation.



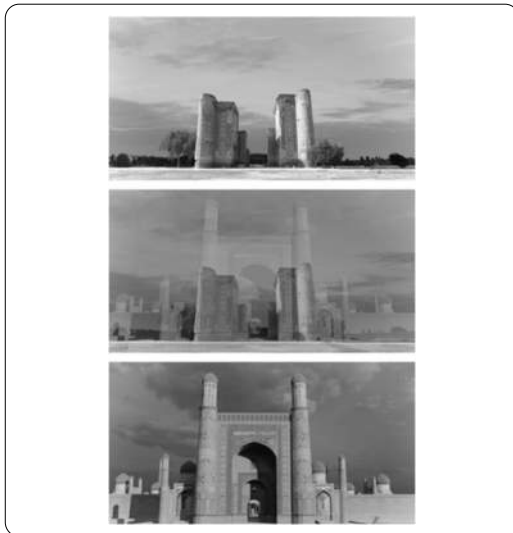
Historical evidence supports the earlier configuration.

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Surviving fabric constrains partial reconstruction



AK-SARAY PALACE

Surviving remains continue to anchor scale and form.

Archival and archaeological evidence supports the missing components.

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Immersive VR expands access at the interpretive end



ANCIENT OLYMPIA

VR can restore spatial experience when the original environment is inaccessible or largely lost.

Immersion does not add historical evidence.

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Methods and delivery across the continuum

MORE DIRECT PHYSICAL EVIDENCE

MORE INTERPRETATION

Intact

EVIDENCE

Direct measurement

DIGITAL APPROACH

TLS and photogrammetry

DELIVERY

Virtual tour or digital twin

Partially lost

EVIDENCE

Surviving fabric plus records

DIGITAL APPROACH

Capture plus reconstruction

DELIVERY

AR, MR, or virtual tour

Largely lost

EVIDENCE

Limited fabric plus comparative evidence

DIGITAL APPROACH

Interpretive 3D modeling

DELIVERY

AR or VR

Non-extant

EVIDENCE

Historical and archaeological records

DIGITAL APPROACH

Historical reconstruction

DELIVERY

Immersive VR

Guidance rather than a fixed prescription

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Visual realism does not measure historical certainty



01 Differentiate documented and reconstructed elements

02 Show alternatives when evidence supports more than one scenario

03 Attach confidence and source metadata

LIMITATION

The framework is qualitative and non-systematic; validation remains future work.

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Heritage condition and evidence should lead technology choice

Reality capture documents what survives.

Reconstruction interprets what is missing.

AR and VR deliver the result with a duty to show uncertainty.

Questions

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