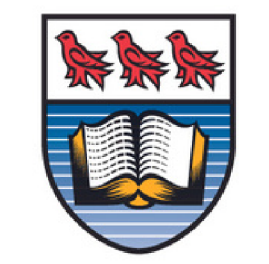


From the Ground Up: A Comparative Analysis of Virtual Reflectance Transformation Imaging and Traditional RTI in the Context of Cemetery Conservation



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Introduction

Reflectance Transformation Imaging (RTI) is an archaeological imaging method often used to reveal worn-down inscriptions invisible to the naked eye. However, its inability to provide metric data, which is crucial for the long-term preservation and monitoring of damage to monuments, poses a significant limitation. In contrast, 3D scanning offers the essential metric data that RTI lacks, facilitating long-term damage assessment. An emerging technique, Virtual RTI, combines RTI's detailed surface imaging capabilities with the metric precision of 3D scanning. This project aims to evaluate the effectiveness of Virtual RTI compared to traditional RTI, exploring its potential to offer the best of both worlds for cultural heritage preservation.

Objective

To compare and analyze the effectiveness and viability of vRTI to traditional RTI in the context of cemetery conservation with a focus on inscription recovery. Though vRTI can be conducted using a variety of 3D scanning methods, I will specifically be focusing on vRTI via structured light scanning.

Methods

1. Capture and render a series of RTI files of worn gravestones at the Emanu-El Cemetery.
2. Contract a local 3D scanning technician to use a structured light scanner on the same gravestones to generate highly detailed 3D models of each monument.
3. Use Blender, a 3D modelling software, to create a virtual RTI render of each monument.
4. Conduct a comparative analysis of each method based on the following factors:
 - a. Inscription visibility and detail
 - b. Cost of required equipment and/or contractors
 - c. Capture & processing time
 - d. Lighting & power requirements
 - e. Ease of use & level of expertise required
 - f. Distribution options for the final product

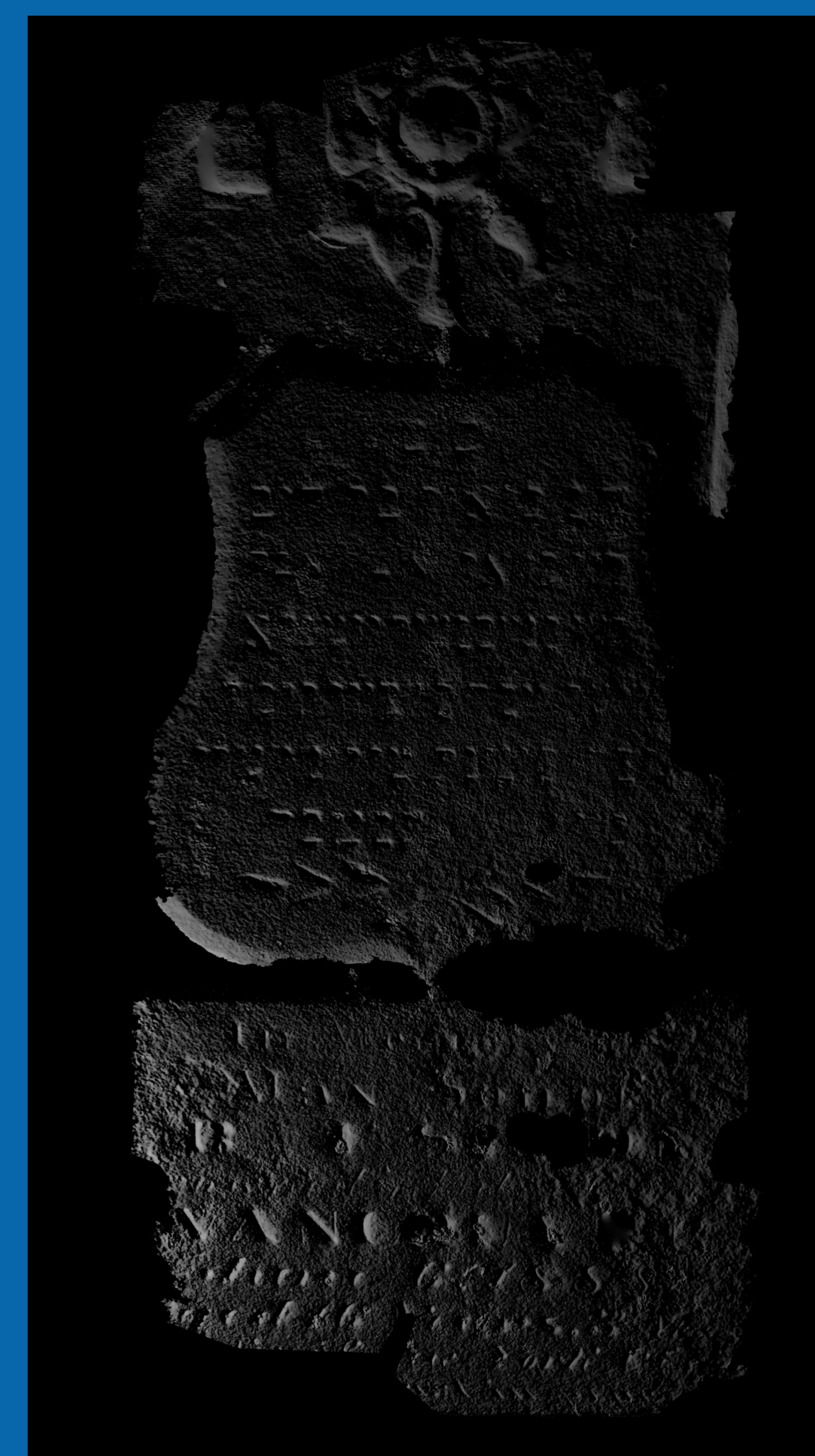
Virtual RTI will one day be the gold standard in the field of cemetery conservation, but traditional RTI will continue to reign supreme for the time being.



A top-down photo of a monument with no visible inscription



A normal map of the same monument generated via RTI



A rendering of the same monument created via vRTI

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Imaging Methods

Reflectance Transformation Imaging

RTI is a low-cost imaging technique that generates a 2.5D image which allows the user to control the position of the light source, providing a marked increase in the visibility of fine surface detail on an object, such as faded inscriptions on a marble gravestone. An RTI image is created by taking a series of photographs of an object from a stationary position while moving a strong light source around the object in a dome-like pattern, which specialized RTI software is then able to stitch together to form these 2.5D pictures.

Structured Light Scanning

SLS is a 3D scanning technology that projects a pattern of stripes onto an object. These stripes deform when they encounter the object's surfaces, and the scanner captures this deformation. The resulting data is then used to reconstruct the object's three-dimensional shape with a high level of precision.

Virtual RTI

vRTI is an emerging method that has only been developed over the past few years, which combines RTI with 3D modelling. Essentially, a highly detailed 3D model of an object is created, usually via SLS or photogrammetry, which is then virtually relit using a light source rendered in 3D modelling software.

Results

- RTI offers a variety of benefits that vRTI via SLS doesn't, including:
 - Much lower barrier to entry both equipment and skill-wise.
 - Is substantially quicker than SLS both for capturing and processing.
 - Fewer restrictions on when you can capture images, as SLS requires very low-light (ideally nighttime) conditions.
 - More transportable, as SLS requires an electrical connection to operate.
 - New RTI software allows for easy distribution of highly engaging data.
 - Does not require any physical contact or modification of monuments being captured, whereas SLS works best when a white powder is sprayed over the surface to prevent reflections from confusing the scanner.
- However, vRTI stands out in the following ways:
 - Provides precise metric data on the shape and size of the monument.
 - Provides an RTI file that can be just as useful for inscription recovery as traditional RTI, provided you have a computer that can process a very high resolution 3D model.
 - Allows one to track degradation of a monument over the long-term, by taking another scan and using software to highlight differences between the new one and the old one.
 - Allows for the possibility of re-creation or restoration of the monument if desired.

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