

# Atta texana leafcutting ant colony: a view underground

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Figure 1. *Atta Texana* colony on an immersive visualization system

## 1. Introduction

The *Atta* project maps tunnels and chambers of a vast leafcutting ant colony. A Ground Penetrating Radar scan was translated into a 3D model that can be viewed on an immersive visualization system, scaling the viewer to ant size. The scanning is nondestructive and is the first time GPR has been used to map a living ant colony. To achieve this goal, the project combines the site-specific nature of an indexical system, GPR, with the ability of an algorithm to parse the data. The model retains a formal connection with its subject and can be distributed and viewed in many different ways.

## 2. Exposition

One of Texas's smallest natives is also one of its largest: myrmecologists refer to ant colonies as superorganisms. *Atta texana* harvests tree leaves to farm a fungus in underground cavities that can spread over more than an acre of land and reach to great depths, with over a million ants in residence. Excavated leafcutting ant nests have proven large enough to contain a 3-story house. [Moser 1963] Previous attempts to model ant colonies have been undertaken by myrmecologist Walter Tschinkel, whose technique involves pouring casting material into the nest, digging it up and piecing it back together. Another method involves using a bulldozer to scrape away successive layers of soil and measuring the diameter of the holes. Tunnels collapse with this method and cannot be tracked. If measurement is the aim, either approach could be used. But our goal was to gain a unique view of this subterranean architecture using a method that would not disturb the colony.

Ground Penetrating Radar (GPR) sends high frequency radar pulses from a surface antenna into the ground. Elapsed time between when the pulse is transmitted—reflected from buried materials or sediment and soil changes—and when it is received, is measured. The sender and receiver are moved along the surface, following transects of a grid. GPR scans contain noise (soil composition, radio interference, and magnetic properties of substances) which can interfere with the results. [Leckebusch 2001] The data was first filtered to reduce noise. We then differentiated voids from soil and other materials by targeting the velocity of radar waves in air (the speed of light —  $3 \times 10^8$  meters per second) in relation to other geologic materials (with an average velocity

of  $1 \times 10^8$  meters per second). An algorithm processed isosurfaces from density values distributed within the overall volume. The result formed polygons nested in layers corresponding to different densities in the GPR scans. [Nakamura 2006] Thus, one can enable successive layers surrounding voids to hint at tunnel structure and fungus caches. Scale changes provided by an immersive visualization system transformed the viewer into the size of an ant surrounded by the tunnel architecture. [Figure 1] [Parke 2005]

## 3. Conclusion

GPR delivers an indexical signal, formed by the action of radar pulses passing through substances over time and distance. In this way it can be loosely compared to a photograph, formed by the pattern of light striking a photosensitive surface. Photographer Henri Cartier-Bresson described taking a photograph as fixing a “decisive moment,” a confluence of the artist's position in relation to the geometry of an unfolding event. Indexical signs offer what Roland Barthes termed the punctum, a specific feature of the subject that cannot be separated from time or place. Conversely, digital representations often rely on generalization of physical phenomena. Gravity, water, or terrain are simulated with algorithms, freed from substance and geographic locale. Due to its mathematical structure, an algorithm enables fluid recomposition of one form into another. In mapping an *Atta* nest, a connection is maintained with this particular subject deep in the soil of a Texas field, while the colony architecture is simulated in a medium distributable across time and space.

## References

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