Structures made by termites and spiders

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Many organisms in nature construct intriguing shapes. Humans have long drawn inspiration from these natural structures, applying them to engineering fields such as architecture [1]. The structures built by organisms themselves are remarkably intricate, with many of their shapes and formation processes remaining a mystery. This study delves into the unique curved surfaces found in fungus gardens of fungus-farming termites and funnel webs of spiders; a topic that has not been extensively explored. The primary goal of this study is to unravel the morphological characteristics of these structures and to uncover potential engineering applications.

First, fungus gardens composed of specialized termite feces have porous structures. The surface of the fungus garden in the termite mound is covered with numerous mycelial pellets of *Termitomyces*, which are 2-3 mm in size. The three primary roles of the fungus garden are a source of nitrogen as preserved foods, an external digestive system to facilitate cellulose breakdown and a cellulase source. In addition, the fungus garden increases CO_2 levels to stabilize the mound's temperature and humidity using the mound's ventilating system [2]. In this study, the fungus garden of *Macrotermes gilvus* was observed using a computed tomography scanning model using the inspeXio SMX-225CT FPD Plus, as shown in Figure 1. The red line shown in Figure 1 is the cross-section of the scanned STL model when cut in a particular plane. The authors collected the specimen at the Sakaerat Environmental Research Station in Thailand. The shape of the fungus garden differs for each species of fungus-farming termites, and they were CT-scanned for each of them. This observation shows that the surface has a complex curve, and the cross-section confirms that the structure is internally branched and hierarchically connected.

Second, spiders in the family *Agelenidae* create funnel-webs, as shown in Figure 2. Many studies have been conducted on the shape of spiderwebs, and most of them are orb webs composed of two-dimensional radial and spiral threads; however, only approximately 10% of all spiders create orb webs. Some studies have applied the Spider Web Scan (SWS) laser-supported tomographic method to develop an experimental technique that directly measured the three-dimensional sheet-web shape using a laser and reconstructed a digital 3D model [2]. This study focuses on the formation process of the funnel-web created by *Agelenidae* to understand the curved surface's characteristics based on geometric formation factors.

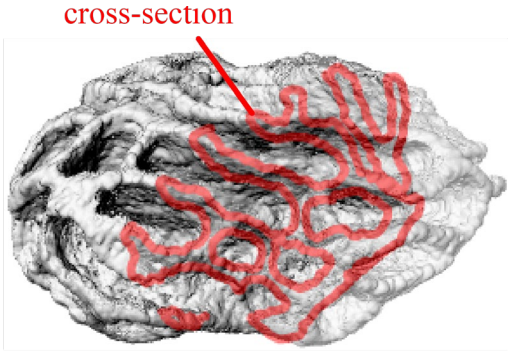

Figure 1 STL model of fungus comb using CT scan.

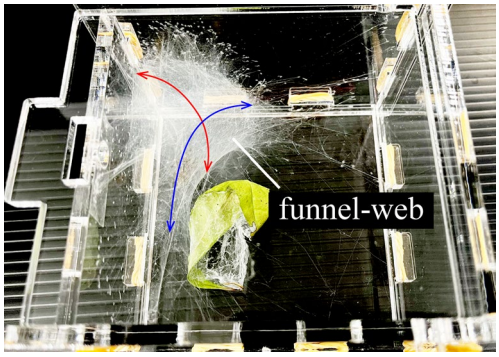

Figure 2 Spiderweb of *Agelena sylvatica*.

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