Influence of Bark on the Measurement of Mechanical Strain using ARAMIS

Arboriculture researchers have begun utilizing the ARAMIS 3D image correlation systems, introduced to arboriculture by NASA engineers, to understand how trees respond to static and dynamic loading. West Virginia University system has acquired an ARAMIS system, and we are beginning to develop research protocols to utilize this promising tool. The basic technique is to develop a series of reference points that are captured by the high resolution 3D imaging system and processed to allow for measurements such as vectors, acceleration and strain (displacement of wood related to the original length). During static trials, the contrast of black dots, or speckling, on top of a coat of white paint serves as the reference points. The image correlation system measures the movement of the black dots during loading and correlates this to vectors, acceleration and strain.

One potential limitation of the ARAMIS system is that phloem and xylem are separate tissues that can potentially move independently. As such, researchers have often removed the bark and painted directly on the wood during static trials of the ARAMIS system in order to measure strain in the xylem. The need to remove the bark significantly increases preparation time and relegates the static application of this system solely to destructive sampling of stems or branches. Unfortunately bark removal limits the ability to monitor individual trees over multiple growing season. Hence the possibility to monitor how tree growth may be modified by extreme loading, pruning, or other manipulation will be eliminate. An additional concern is adherence of the base paint coat to the newly exposed xylem. During initial test on freshly stripped red maple branches, the base coat did was easily rubbed off, suggesting that the paint fit more like a tight glove that may move somewhat independently rather that fully adhere to the wood fibers.

Since photosynthate and gas exchange takes place between phloem and xylem, the independence of the two tissues might be minimal, especially during times of the year when radial growth is not actively occurring. Our research will determine if a relationship exists between mechanical strains measured bark intact and strains measured after bark removal in order to determine if bark removal can be avoided in some instances. This relationship could then be used to allow for testing of individual trees over successive growing without the need to remove the bark.

Branches will be removed from trees and sectioned in the field. The samples will be brought to the WVU Wood Science laboratory and prepared for testing by applying a white background and black reference points. The branches will be loaded using a universal load press by applying a consistently increasing load to a fixed level. The ARAMIS system will monitor the midpoint of each sample during loading in order to calculate strain at the same location. Care will be taken to assure that all loading stays within the elastic limit of the wood. Two tests will be conducted on each sample; the first with bark in place and the second with the bark removed. After initial trials on a single species, additional species will be tested to determine applicability of the bark-on strain measurement protocol.

The presentation will discuss the results of a research project that examines stain in samples with bark on and bark removed. The direct comparison will help determine if bark can be left in place, which would allow individual trees to be monitored over multiple growing seasons.

Biography

Dr. Dahle is an Assistant Professor of Arboriculture and Urban Forestry in the Division of Forestry & Natural Resources at West Virginia University and an ISA Board-Certified Master Arborist. Dr. Dahle's research utilizes allometric modeling and tree biomechanics to understand how urban trees grow and survive environmental loads such as those from snow and ice storms. He has worked as an arborist managing commercial and municipal tree care accounts in the San Francisco Bay Area and served as a consulting utility arborist with the Davey Resource Group throughout northern California. Additionally, he worked with the Bartlett Tree Research Laboratory.