Tree of Life: Tree-Mounted Antenna and Accessible Ground Station

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The Tree of Life is a mission which ultimately aims to demonstrate mission longevity through use of a CubeSat in low-Earth orbit coupled with ground stations on Earth based around trees. Data on the trees and from the CubeSat would be used to serve art and science goals. One of the principal intentions of the project is for it to be widely accessible to audiences of different experience levels so that they may participate in the collection and use of data. To further this project, an accessible way for participants to receive data from the proposed satellite in low-Earth orbit at the tree was needed. Previously demonstrated was the use of a loop antenna mounted on a tree trunk or branch to estimate the dielectric properties of the tree, and consequently make inferences about the physiological state of the tree. Here, we further explored the use of this tree mounted antenna as part of a receiving station for data packets from satellites in low-Earth orbit. We designed a low cost and flexible ground station composed primarily of commercially available components or parts which can be made without significant overhead or resources. The tree-mounted antenna was integrated into this system in a variety of configurations, including single and multi-antenna versions. In testing with existing satellites in low-Earth orbit, downlink was successfully achieved. That said, the performance of the system was not competitive with other existing receiving station that do not have to contend with being mounted onto a tree and attenuation that such an environment causes. So, in the niche applications where the receiving station must be physically very close to a tree, this solution does make some sense. However, for reliability a more traditional ground station would behave more consistently. In the context of the Tree of Life mission, this solution is considered to be a valid secondary form of data downlink, especially for crowdsourced operators with limited resources.