Abstract:
In the current energy crisis resulting from extensive use of depleting fossil fuels, biomass pellets are a feasible and environmental-friendly alternative renewable energy source. Ironically, pelletization is a high energy consumption process, which needs further improvement to maximize energy and cost savings. Ground biomass particles are the fundamental building blocks that lead to the formation of the final assembly, therefore, it is of utmost importance to understand the biomass densification mechanism from the microscale up to the macroscale. This study addresses engineering challenges in measuring the mechanical responses of bonded particles and determining the coordination number to attain a stable quality assembly. In our recent study, the micromechanical characterizations of conditioned and unconditioned switchgrass individual particles were performed using micromechanical extensometer devices, inspired by the MicroElectroMechanical-Systems. The strength of bonded particles at microscale is a part of the ongoing efforts to determine the strength of the pellets and to elucidate the contribution of natural binders to pellet formation. Assemblies formed at different conditions will be investigated to quantify the coordination number and corresponding contact area required for strong and durable pellets using microscale resolution a Computerized Tomography scan. This knowledge framework will enable relating the fundamental microscale properties of particles to macroscale quality properties of pellets.