

Alex Thomasson¹, Mike Kolomiets¹, Dmitry Kurouski¹, John Mullet¹, Seth Murray¹, Shay Simpson¹, and Troy Vann¹

¹Affiliation not available

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Automated Precision Phenotyping (APP) Greenhouses at Texas A&M University

J. Alex Thomasson, Mike Kolomiets, Dmitry Kurouski, John Mullet, Seth Murray, Shay Simpson, Troy Vann

Texas A&M University recently completed a set of Automated Precision Phenotyping (APP) Greenhouses that incorporate robotic systems for automated collection of advanced sensor-based plant phenotypes. Transiting the length of a greenhouse is a gantry beam, on which a rolling truck provides a second axis of motion along the gantry. Attached to the truck is a 3.0-m long robotic arm that is controlled to position a sensor head at virtually any position relative to any plant in a greenhouse. The robotic arm can be programmed to operate quickly and safely in complicated scanning patterns to enable data collection on all plants in the greenhouse within a time window of a few hours, ensuring consistent conditions during data collection. The sensor head includes a high-speed multispectral camera and eventually a Raman spectrometer. Relative to phenotyping greenhouses at other institutions, the APP Greenhouses have the advantage of maximum flexibility in configuration of plants in the greenhouses, in positioning of sensors relative to the plants, and in the types of sensors used, making research capabilities in the APP Greenhouses truly unique. Preliminary data have been collected on sorghum and maize plants. Four-band multispectral images have been collected daily, scanning the side of each plant from top to bottom. Preliminary software development is directed at automated image stitching to create a full side-view image of each plant, from which consistent metrics can be automatically calculated, such as plant height, stalk diameter, leaf angle, etc.