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General Comment

I urge the NSF (and also USDA) to fund artificial intelligence (AI) research focused on critical agricultural applications in order to support farm production in light of the lack of available farm labor, to improve the livelihoods of rural Americans, and to maintain food security. A particular aspect of AI that urgently needs research to deal with these issues is AI for autonomous agricultural systems (i.e., agricultural autonomy). U.S. agriculture needs agricultural autonomy to mitigate the growing lack of labor, to enhance safety and efficiency in farming, and to optimize crop management at a very precise level. AI is critical to developing agricultural autonomy capabilities. Solutions to simple agricultural autonomy problems are emerging, like GPS and inertial autonomous guidance, but only for elementary tasks like tillage on large, open, flat fields. In complex agricultural environments, great difficulty exists in autonomous perception for various tasks like detection and characterization of fruit for harvesting and limbs for pruning, and avoidance of obstacles including negative obstacles like holes and ditches. Agricultural autonomy requires sensors to provide situational data, AI to analyze the data and make decisions, and electromechanical systems to translate the decisions into physical action like navigation or precise movement of robotic arms and end-effectors (e.g., grippers). Whereas autonomous mobile robots have become commonplace for moving boxes and pallets in distribution warehouses, where environments are controlled and relatively simple to navigate, the complexity associated with numerous crops, cropping systems, field shapes and sizes, topography, etc., makes developing highly sophisticated agricultural autonomy extremely challenging. It is critical to bridge existing gaps in AI that are slowing the development and adoption of agricultural. The focus should be on building and expanding large, curated, open-source datasets for complex agricultural operations, building collaboration between agricultural researchers and computer scientists, and expanding information sharing regarding AI for agricultural autonomy. Some activities that should be undertaken are to make benchmark data available to researchers nationwide and span a wide range of agricultural autonomy applications, enable development of AI algorithms and architectures specifically developed for agricultural autonomy, and accelerate advancement in agricultural autonomy through collaboration and sharing of data.