Announcing the Final Examination of Sinem Defterli for the degree of Doctor of Philosophy

Time & Location: June 29, 2018 at 2:00 PM in ENG 2 202A
Title: Bio-inspired Visual Servo Control of a Picking Mechanism in an Agricultural Ground Robot

For a recently constructed disease detection agricultural ground robot, the segregation of unhealthy leaves from strawberry plants is a major task in field operations. In this dissertation, the motion planning of a custom-designed picking mechanism in the ground robot is studied in two sections. First, a set of analytical, sub-optimal semi-analytical and numerical algorithms are studied to solve the inverse kinematics problem of the handling mechanism in firm circumstances. These premeditated approaches are built on the computation of the joint variables by an identified 3D position data of the target leaf. The outcomes of the three solution algorithms are evaluated in terms of the performance indexes of energy change and the CPU time cost. The resultant postures of the mechanism for different target point locations are observed both in simulations and the hardware experiments as a result of three derived inverse kinematics solution algorithms. Secondly, after the manipulation task of the mechanism via the proposed inverse kinematic algorithms is performed, some compensation may be needed due to the sudden and unpredicted deviation of the target position under field conditions. For this purpose, an image-based visual servoing method via the camera-in-hand configuration is activated when the end-effector is in the close proximity of the target leaf subsequent to performing the inverse kinematics algorithms. In this part of the study, a bio-inspired trajectory optimization problem in image-based visual servoing (IBVS) method is constructed based on the mathematical model derived from the prey-predator relationships in nature. In this biological phenomenon, the predator constructs its path in a certain subspace while catching the prey. When this motion strategy is applied to trajectory optimization problems, it causes a significant reduce in the computation cost since it finds the optimum solution in a certain manifold. The performance of introduced bio-inspired trajectory optimization is validated in hardware experiments both in laboratory settings and in field conditions.

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Approved for distribution by Yunjun Xu, Committee Chair, on June 15, 2018.

The public is welcome to attend.