2021 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

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Integrated Design of Sensing, Network, and Cooperative Control of Multi-Vehicle Systems for Preventing Frost and Freeze Damage to Flowers and Buds of Fruit Trees (Award ID#: 1836974)

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Challenge:

- Among many weather-related risks, frost events can damage crops significantly and lead to substantial economic losses.

Solution:

- To maintain better consistency of heating, ensure that all parts of the orchard are properly heated, constant monitoring of the orchard temperatures through the use of UAVs and mounting heaters on a UGV can be a solution.

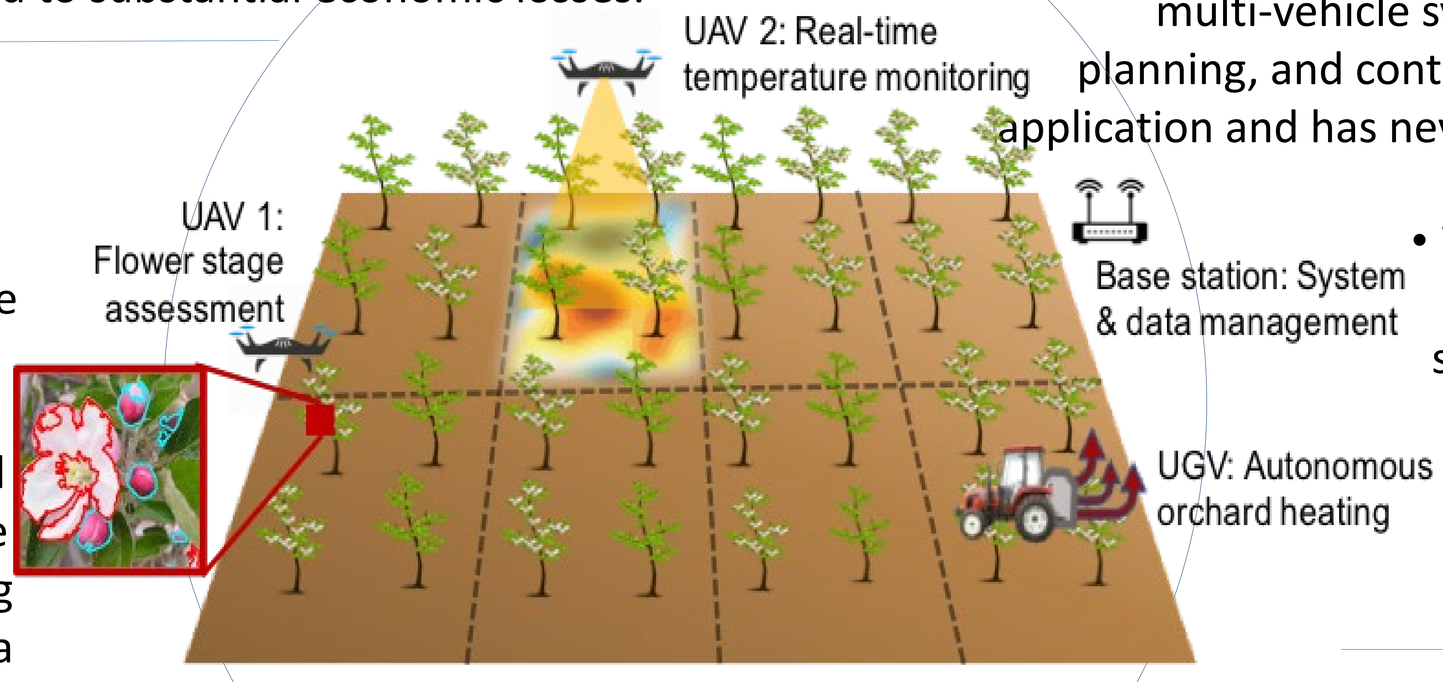

Fig. 1. Overview of the proposed CPS system for frost protection in an apple orchard.

- Integrated autonomous vehicles, real-time data analytics, decision making, and Internet of Things (IoT) communications can significantly reduce the cost and increase the precision of frost protection of fruit trees.

Scientific Impact:

- Frost protection using a novel combination of a multi-vehicle system for sensing, mission planning, and control in real-time is a unique application and has never been tested in orchard conditions.
- The developed system will be transferable to various sizes of orchards and types of crops as long as the appropriate hardware is available.

Broader Impact:

- Every year, the U.S. produces an average of 15 million tons of deciduous fruit. Higher efficiency in frost protection can potentially provide significant economic impacts to the industry as well as rural communities