Mobile Robotic Lab for In-Situ Sampling and Measurement

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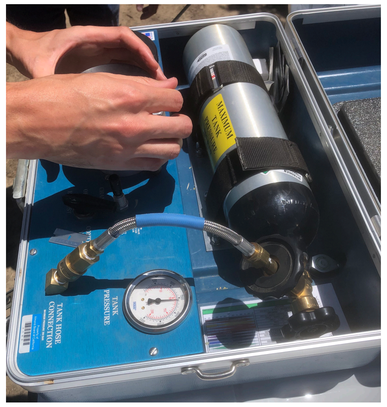
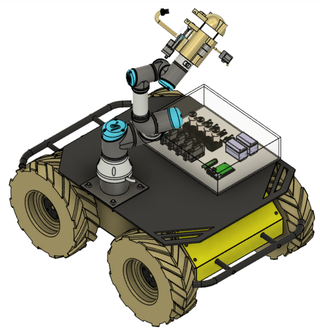
Problem



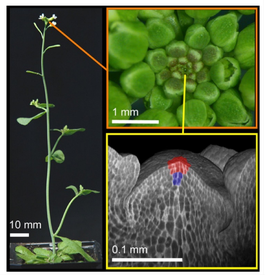
- Leaf water potential measurements are key to precision agriculture but are time consuming
- Measurements must be frequent in time and spatially dense
- Data collection with pressure chambers is the current bottleneck
- Accurate leaf water potential determination leads to more sustainable irrigation scheduling

Proposed Solution



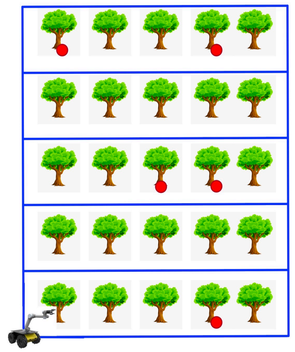
- Automate the sampling/analysis process
- Robots identify *interesting* regions to sample, navigate to points of interest, pick a leaf and perform analysis in situ

Technical Challenges and Tasks



- Leaf picking and pressure chamber development
- Resource optimization and planning
- Visual sensing for accurate determination of leaf water potential
- Field validation

Recent Results



- Algorithms for Stochastic Orienteering with Chance Constraints
  - Optimizes single robot deployment under uncertainty in travel times
  - *Path policies* account for stochastic travel times
  - Chance constraints allow to specify tolerable probability of failure
- Algorithm for task planning under uncertainty
  - Uncertain task costs; gain of completing a task proportional to resource consumption
  - Simultaneously determines optimal tasks to perform and optimal time to exit, *at run-time*
  - Applies to both single- and multi-robot teams with heterogeneous energy (for movement) and resource (for task execution) budgets
- Mobile robot navigation pipeline for automated continuous apparent soil electrical conductivity measurements
  - Important for estimating soil salinity and linking to irrigation scheduling
  - Robotic-measured soil maps similar to manually-conducted baseline
- Preliminary feasibility field tests (manual) of the whole leaf sampling and analysis pipeline

Tech Transfer: Two provisional patent applications
Student training: Two PhD students graduated (one at UCM, one at UCR)

References

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