Multi-Object Tracking in Agricultural Scenarios

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Motivation

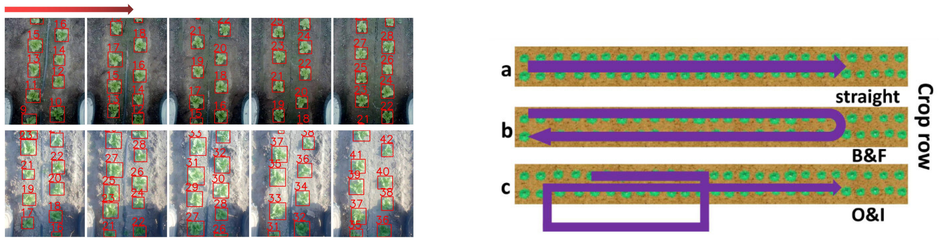
- The steadily increasing global population imposes new challenges to agricultural and food systems.
- The need for efficient food production is compounded by the decreasing availability of agricultural workers.
- Most applications using autonomous robots are developed in urban and industrial automation scenarios.
- Relevant applications in agriculture are: **automated spray of pesticides or fertilizer, and fruit counting**.
- Reliable object tracking is required since the plants and fruits should be **sprayed or counted exactly once**.

Background

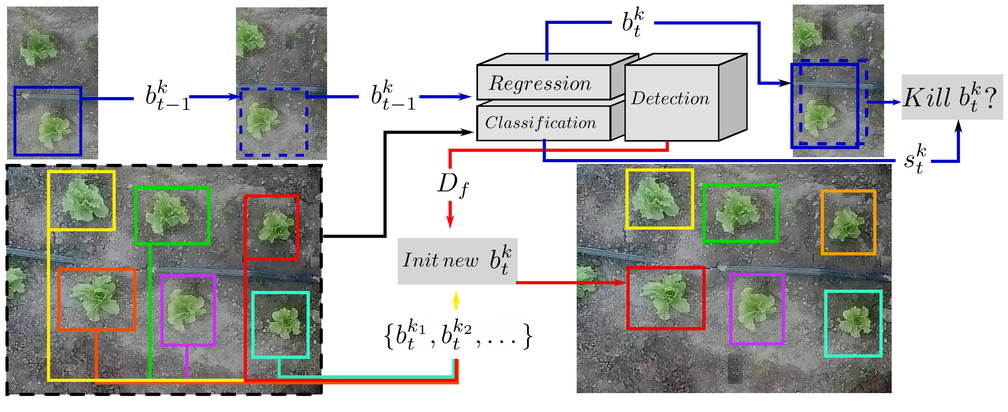
- The use of autonomous robots in agricultural scenarios is still under-explored.
- The most recent **detection and tracking methods rely on deep learning-based computer vision models**.
- Although object detection is a challenging task, it can be performed more effectively than object tracking.
- The challenges of object tracking applications are mostly false or missed detections and occlusions.

Methodology

As a case study, we focus on one of the largest publicly available datasets for plant tracking: LettuceMOT [1].

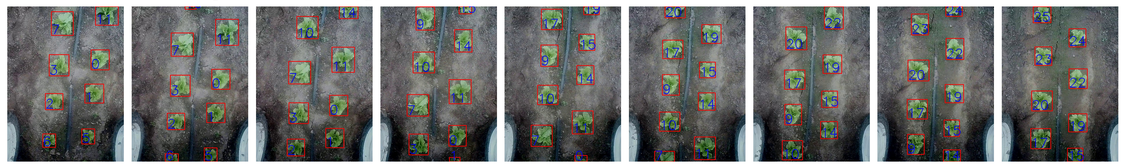


Our current tracking experiments are based on modified versions of Tracktor++ [2].



Results

Qualitative results sequence 1 (straight2):



Qualitative results sequence 2 (B&F1):

Quantitative results compared to the best result in [1]: ByteTrack+NSA Kalman Filter.

Dataset	Method	MOTA	IDF1	Dataset	Method	MOTA	IDF1
straight2	Best in [1]	90.2	**94.7**	straight4	Best in [1]	86.4	92.7
	Ours	**96.7**	94.5		Ours	**96.9**	**93.1**
B&F1	Best in [1]	91.9	59.7	B&F2	Best in [1]	86.5	52.1
	Ours	**96.0**	**60.1**		Ours	**95.9**	**53.9**
O&I1	Best in [1]	89.9	58.7	O&I2	Best in [1]	51.3	46.2
	Ours	**97.6**	**60.0**		Ours	**96.8**	**56.9**

Broader Impacts, Conclusions, and Future Work

Recent contributions like the lettuceMOT benchmark have helped the exploration of methods for **automated robot spraying of pesticides or fertilizers in agricultural fields**. The advance in tracking methodologies for applications such as this allows for more **reliable automation of food production**.

We have presented a modified version of the well-known tracker Tracktor++. Our preliminary experiments **show state-of-the-art tracking performance in the LettuceMOT dataset**.

We are conducting a more extensive set of experiments using this and other similar datasets like the Apple MOTS dataset to validate our method with higher significance and reliability.

References

[1] N. Hu, S. Wang, X. Wang, Y. Cai, D. Su, P. Nyamsuren, Y. Qiao, Y. Jiang, B. Hai, and H. Wei, "Lettucemot: A dataset of lettuce detection and tracking with re-identification of re-occurred plants for agricultural robots," *Frontiers in Plant Science*, vol. 13, 2022.

[2] P. Bergmann, T. Meinhardt, and L. Leal-Taixé, "Tracking without bells and whistles," in *2019 IEEE/CVF International Conference on Computer Vision (ICCV)*, pp. 941–951, 2019.