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Coogee Beach

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# Wine Australia



#### TREASURY WINE ESTATES



PRIMARY INDUSTRIES & REGIONS SA PIRSA



SRV

### $\mathcal{N}$ Smart Robotic Viticulture

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The Australian Wine Research Institute





SEE SAW





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# **2010: SPATIALLY SMART WINE**



Norzahari F; et al. 2011, 'Spatially Smart Wine–Testing Geospatial Technologies for Sustainable Wine Production', in Proceedings of FIG Working Week 2011, FIG – International Federation of Surveyors, Marrakech. Morocco, pp. 1 - 19

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# CURRENT PROJECTS











Visual Yield Estimation (VYEP 2014 - 2017) Vine Water Stress (VWS 2016-2017) Bunch Reconstruction (BR 2013 - 2016) Bunch maturity sensing (VM 2015 - 2018)



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# YIELD ESTIMATION AND MAP GENERATION



Cossell S, Whitty M, Liu S, Tang J, 2016, 'Spatial Map Generation from Low Cost Ground Vehicle Mounted Monocular Camera', in IFAC-PapersOnLine, AGRICONTROL, pp. 231 – 236.





# SHOOT DETECTION (GOPRO)



Liu S, Cossell S, Tang J, Dunn G, Whitty M, 2017, 'A Computer Vision System for Early Stage Grape Yield Estimation Based on Shoot Detection', Computers and Electronics in Agriculture

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# SHOOT DETECTION (GOPRO)



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# EARLY YIELD ESTIMATION BY SHOOT DETECTION



# BUNCH DETECTION (PHONE / COMMERCIAL CAMERA)



# VINE WATER STRESS (VWS) ANALYSIS





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# VWS ANALYSIS BY MICROSCOPE IMAGE





### **VWS** ANALYSIS BY THERMAL IMAGE





### FLIR One \$390



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3+

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## **3D BUNCH RECONSTRUCTION**





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### **3D BUNCH RECONSTRUCTION**







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#### About R&D Projects Team Publications Datasets Contact







### TEMPORAL BUNCH TRACKING



Clare Chardonnay

Clare Shiraz

Orange Chardonnay

Orange Shiraz





## FLOWER COUNTING



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### FLOWER DETECTION





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# FLOWER NUMBER ESTIMATION

Experimental results show that the best photograph time for flower estimation is around EL-stage 18.

The single variable linear model has the best performance, compared with four other models.

Four cultivars, in total 533 images, different maturity stages, ex-vivo or in-vivo, various illumination conditions.

Accuracies (against manual counts):

Datasets	AC	Datasets	AC	Datasets	AC	Datasets	AC
CHA 4	0.8787	CHA 7	0.8065	CAS 1		CAS 4	0.8273
CHA 5	0.8572	SHI 4	0.8438	CAS 2	0.8705	CAS 5	0.8651
CHA 6	0.8513	SHI 5	0.8412	CAS 3	0.8558	MER	0.8254



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# MATURITY AND CULTIVAR DEPENDENCY

AC(%)	CHA 2	CHA 6	CHA 7	SHI 2	SHI 5	CAS 2	CAS 5	MER
CHA 2	85.92	78.73	42.26	82.96	50.32	83.6	64.79	82.12
CHA 6	79.75	82.85	49.53	82.77	56.69	83.79	55.71	81.68
CHA 7	66.05	72.6	86.5	70.89	84.47	69.94	47.18	64.44
SHI 2	88.64	88.53	55.95	90.13	67.84	91.02	63.8	84.23
SHI 5	76.01	79.77	71.46	77.2	81.67	79.04	68.7	75.79
CAS 2	87.57	85.83	58.2	87.16	66.63	88.58	70.72	84.23
CAS 5	78.08	79.19	62.31	78.91	72.84	80.94	82.09	79.66
MER	70.67	81.65	49.21	74.66	73.95	77.84	76.59	84.27



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# PASSIVE SENSING FOR MATURITY ESTIMATION





# RAPID + NON-DESTRUCTIVE MATURITY ESTIMATION





# VISIBLE BERRY SUGAR VS WHOLE BUNCH SUGAR





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### REMOTE SENSING OF NON-PRODUCTIVE VINE CANOPY

Uses existing raw aerial imagery (RGB + NIR) Detection of bare-wire from aerial imagery (UAV or manned aircraft) to:

- Detect/localise missing vines
- Detect non-productive canopy and track changes in management practices

Block	Ground-truth	Estimated
40A (2015)	3.77%	3.47%
47A (2015)	18.48%	17.29%
40A (2016)	6.00%	5.52%
47A (2016)	6.74%	5.33%



Tang J; Woods M; Cossell S; Liu S; Whitty M, 2016, 'Proximal and Remote Sensing of Non-Productive Vine Canopy', Sensing, Control and Automation Technologies for Agriculture -5th AGRICONTROL 2016, Seattle, USA, 14 - 17 August 2016



# **OPPORTUNITIES FOR COLLABORATION**

### Why?

Top 50 ranked university with global reach Southern hemisphere vineyards – double your data collection rate Good working relationships with large winemakers (Treasury Wine Estates) as well as many connections through Australian Wine Research Institute (AWRI) Large scale vineyard blocks, good weather conditions

### What do we offer?

Pipeline for processing large datasets of proximal video App backends for beta testing and large scale roll-out Image processing expertise + machine learning Autonomous robot systems <u>Global Connections</u> grants with small – medium companies

Visit Australia!





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# **THANK YOU!**

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