

# **7th IFAC Conference on Sensing, Control and Automation Technologies for Agriculture (AGRICONTROL 2022)**

IFAC PapersOnline Volume 55, Issue 32

Munich, Germany  
14-16 September 2022

**Editor:**

**Timo Oksanen**

ISBN: 978-1-7138-6413-4

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

To the extent permissible under applicable laws, no responsibility is assumed by the Owner, the Publisher or the Licensee for any injury and/or damage to persons or property as a result of any actual or alleged libelous statements, infringement of intellectual property or privacy rights, or products liability, whether resulting from negligence or otherwise, or from any use or operation of any ideas, instructions, procedures, products or methods contained in the material therein.

The publication of an advertisement in the POD Edition does not constitute on the part of the Owner, the Publisher or the Licensee a guarantee or endorsement of the quality or value of the advertised products or services described therein or of any of the representations or the claims made by the advertisers with respect to such products or services.

Copyright© (2022) by the authors  
Open access publication under the CC-BY-NC-ND License  
<https://creativecommons.org/licenses/by-nc-nd/4.0/>  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2023)

For permission requests, please contact the publisher, Elsevier Limited  
at the address below.

Elsevier Limited  
The Boulevard, Langford Lane  
Kidlington  
Oxford OX5 1GB UK

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

Optimal Route Planning and a Turning Method for an Electric Vehicle Robot in an Irregularly Shaped Vineyard .....	1
<i>Yoshitomo Yamasaki, Noboru Noguchi</i>	
Building a Robot Tractor Using Commercial Components and Widely Used Standards .....	6
<i>Juha Backman, Raimo Linkolehto, Madis Lemsalu, Jere Kaivosoja</i>	
Modeling of Tire Lateral Forces in Non-Linear 6-DOF Simulations for Off-Road Vehicles .....	12
<i>Tabish Badar, Juha Backman, Arto Visala</i>	
Slip Detection and Control for Harvesting Machines.....	18
<i>Mirjan Heubaum, Philipp Münch, Giuliano Costantini, Tobias Peschke, Daniel Görge</i>	
Real-Time CNN-based Computer Vision System for Open-Field Strawberry Harvesting Robot.....	24
<i>Madis Lemsalu, Victor Bloch, Juha Backman, Matti Pastell</i>	
Detecting and Localizing Strawberry Centers for Robotic Harvesting in Field Environment .....	30
<i>Zixuan He, Manoj Karkee, Qin Zhang</i>	
Spatio-Temporal Mapping of Cotton Blooms Appearance Using Deep Learning .....	36
<i>Vaishnavi Thesma, Canicius Mwitta, Glen Rains, Javad Mohammadpour Velni</i>	
A Data-Driven Monitoring System for the Early Pest Detection in the Precision Agriculture of Hazelnut Orchards.....	42
<i>Martina Lippi, Renzo Fabrizio Carpio, Mario Contarini, Stefano Speranza, Andrea Gasparri</i>	
A Vision-Based Navigation System for an Agricultural Autonomous Tractor .....	48
<i>Sristi Saha, Tsuyoshi Morita, Ricardo Ospina, Noboru Noguchi</i>	
Ploughing Furrow Detection Based on 3D LiDAR Sensor Data.....	54
<i>Reinhold Poscher, Riikka Soitinaho, Timo Oksanen</i>	
Positioning and Attitude Determination for Precision Agriculture Robots Based on IMU and Two RTK GPSs Sensor Fusion .....	60
<i>David Vieira, Rodolfo Orjuela, Matthias Spisser, Michel Basset</i>	
2D LiDAR Based Object Detection and Tracking on a Moving Vehicle.....	66
<i>Riikka Soitinaho, Marcel Moll, Timo Oksanen</i>	
Trellis Wire Detection for Obstacle Avoidance in Apple Orchards .....	72
<i>Santosh Bhusal, Uddhav Bhattarai, Manoj Karkee</i>	
Improved ResNet Based Apple Leaf Diseases Identification.....	78
<i>Ruirou Ding, Yongliang Qiao, Xianghai Yang, Honghua Jiang, Huixiang Liu</i>	
Semantic Image Segmentation with Deep Learning for Vine Leaf Phenotyping .....	83
<i>Petros N. Tamvakis, Chairi Kiourt, Alexandra D. Solomou, George Ioannakis, Nestoras C. Tsirliganis</i>	
Investigation of the Added Value of CycleGAN on the Plant Pathology Dataset.....	89
<i>Bart M. Van Marrewijk, Gerrit Polder, Gert Kootstra</i>	

LiDAR-Odometry Based UAV Pose Estimation in Young Forest Environment .....	95
<i>Issouf Ouattara, Vesa Korhonen, Arto Visala</i>	
UAV-UGV Collaborative Localisation with Ambiguity Aversion by UAV Re-positioning .....	101
<i>A. H. T. E. De Silva, Jay Katupitiya, Andrey V. Savkin</i>	
Sensor Optimization for Altitude Estimation of Spraying Drones in Vineyards .....	107
<i>Thomas Severin, Dirk Söffker</i>	
Practical Use of Deep Learning-Based Daily Stem Elongation Measurement of Tomato Plants in Two Commercial Greenhouses .....	113
<i>S. Toda, T. Higuchi, T. Kanoh, T. Sakamoto, K. Takayama</i>	
Determining Fresh Tomato Weight Using Depth Images from an AR Headset.....	119
<i>Tim Van Daalen, Joseph Peller, Jos Balendonck</i>	
Canopy Density Estimation of Apple Trees .....	124
<i>Achyut Paudel, Manoj Karkee, Joseph R. Davidson, Cindy Grimm</i>	
Persistent Monitoring for Indoor Farming Using Static and Mobile Sensors.....	129
<i>Karlisa Priandana, Made Widhi Surya Atman, Azwirman Gusrialdi</i>	
State Estimation of Pest Populations Subject to Intermittent Measurements .....	135
<i>Nicolas Bono Rossello, Luca Rossini, Stefano Speranza, Emanuele Garone</i>	
Nonlinear Observability Analysis and Joint State and Parameter Estimation in a Lettuce Greenhouse Using Ensemble Kalman Filtering.....	141
<i>Sjoerd Boersma, Simon Van Mourik, Bolai Xin, Gert Kootstra, Daniela Bustos-Korts</i>	
Irrigation Control by Mimicry .....	147
<i>J. M. Manzano, J. Bareiro, G. B. Cáceres, J. R. Salvador, P. Millán</i>	
Dimensionality Reduction of High-Throughput Phenotyping Data in Cotton Fields.....	153
<i>Amanda Issac, Himani Yadav, Glen Rains, Javad Mohammadpour Velni</i>	
Early Detection of Toppling Susceptibility in Tulip Using Spectral Imaging .....	159
<i>Selwin Hageraats, Sjoerd Van Vilsteren, Gerrit Polder, John Trompert, Jeroen Wildschut</i>	
Stereo-Vision Solution for Measuring Plant Area Index in High Tunnel Crops .....	165
<i>Alejandro Tapia, Luis Orihuela, James B. Romaine, José R. Salvador</i>	
A Drone-Based Prototype Design and Testing for Under-the-canopy Imaging and Onboard Data Analytics.....	171
<i>R. Oliver Zanone, Tairan Liu, Javad Mohammadpour Velni</i>	
Robust Sample-Based Model Predictive Control of a Greenhouse System with Parametric Uncertainty .....	177
<i>Sjoerd Boersma, Congcong Sun, Simon Van Mourik</i>	
Deficit Irrigation-Based Growth Control of Maize Plants Using Hybrid Model Predictive / Trellis Decoding Algorithm.....	183
<i>Lina Owino, Dirk Söffker</i>	
A Hybrid Dynamical Systems Approach to Smart Irrigation.....	188
<i>R. Bertollo, G. B. Cáceres, P. Millán, M. Pereira, L. Zaccarian</i>	

Economic Model Predictive Control for Interactions of Water Sources Connected Crop Field .....	194
<i>G. B. Cáceres, M. Pereira, P. Millán</i>	
Connecting Agricultural Robots and Smart Implements by Using ISO 11783 Communication.....	200
<i>Dimitrios S. Paraforos, Cristophe Aubé, Loukas Athanasakos, Ioannis Avgoustakis, Frits K. Van Evert</i>	
Event Ontology About Wheat Cultivation .....	206
<i>A. Stoyanova-Doycheva, E. Doychev, V. Ivanova, V. Valkanov, V. Tabakova-Komsalova</i>	
Approach for Modeling and Implementation of an Intelligent System for Livestock Cattle on Pastures.....	211
<i>Evgeni Valchev, Pencho Malinov, Todorka Glushkova, Stanimir Stoyanov</i>	
Semantic Knowledge for Autonomous Smart Farming.....	217
<i>Ganesh Ramanathan, Danai Vachtsevanou, Kimberly García, Jérémy Lemée, Simon Mayer</i>	
In-Field Static Spread Pattern of a Centrifugal Spreader by Considering Field Topography.....	223
<i>Galibjon M. Sharipov, Andreas Heiß, Sulaymon L. Eshkabilov, Hans W. Griepentrog, Dimitrios S. Paraforos</i>	
Introducing Metrics to Analyse the Performance of Automatic Section Control for Agricultural Machines .....	229
<i>Samuel Brodie, Timo Oksanen</i>	
Condition Monitoring Using Convolutional Neural Network in Agricultural Machinery - Use Case: Disc Mower .....	235
<i>Michael Jaumann, Ertug Olcay, Timo Oksanen</i>	
Predicting Equilibrium Moisture Content of Mushrooms by NARX Neural Network and First Order Kinetic Modelling Approaches .....	241
<i>Dimitrios Argyropoulos, Dimitrios S. Paraforos</i>	
Modeling and Simulation of Aquaculture Systems .....	247
<i>Sandra Viehöfer, Philipp Brauer, Dirk Söffker</i>	
Vector Field Based Tracking of a Dynamic Wildfire Boundary with an UAV.....	253
<i>Licheng Feng, Jay Katupitiya</i>	
Optimization of a Low Loss Strategy for Combine Harvesters Based on Bayesian Network.....	259
<i>Yehong Liu, Dong Sun, Xindong Ni, Shumao Wang, Xin Wang</i>	
Results on Spatio-Temporal Estimation of Temperature and Soil Moisture in La Colmena (Paraguay) .....	265
<i>J. M. Manzano, Luis Orihuela, Erid Pacheco, Mario Pereira</i>	
3D Map Reconstruction of an Orchard Using an Angle-Aware Covering Control Strategy.....	271
<i>Martina Mammarella, Cesare Donati, Takumi Shimizu, Masaya Suenaga, Fabrizio Dabbene</i>	

## **Author Index**