

UNIVERSITY OF ALICANTE

PHD THESIS

TBD

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*A thesis submitted in fulfilment of the requirements
for the degree of Doctor of Philosophy*

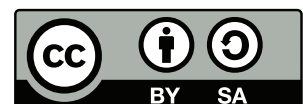
in the

3D Perception Lab
Department of Computer Technology

February 4, 2019

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“Will robots inherit the earth? Yes, but they will be our children.”

Marvin Minsky

Abstract

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Resumen

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Acknowledgements

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List of Acronyms

Introduction

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1.1 Motivation

1.2 Approach

1.3 Contributions

1.4 Co-Authored Papers

This thesis is the result of continuous effort throughout the last years. Such efforts have sometimes crystallized in form of co-authored publications and conference talks.

1.4.1 Chapter 2

- Alberto Garcia-Garcia, Francisco Gomez-Donoso, Jose Garcia-Rodriguez, et al. “PointNet: A 3D Convolutional Neural Network for real-time object class recognition”. In: *2016 International Joint Conference on Neural Networks, IJCNN 2016, Vancouver, BC, Canada, July 24-29, 2016*. 2016, pp. 1578–1584. DOI: [10.1109/IJCNN.2016.7727386](https://doi.org/10.1109/IJCNN.2016.7727386). URL: <https://doi.org/10.1109/IJCNN.2016.7727386>
- Alberto Garcia-Garcia, Jose Garcia-Rodriguez, Sergio Orts-Escolano, et al. “A study of the effect of noise and occlusion on the accuracy of convolutional neural networks applied to 3D object recognition”. In: *Computer Vision and Image Understanding* 164 (2017), pp. 124–134. DOI: [10.1016/j.cviu.2017.06.006](https://doi.org/10.1016/j.cviu.2017.06.006). URL: <https://doi.org/10.1016/j.cviu.2017.06.006>
- Francisco Gomez-Donoso, Alberto Garcia-Garcia, Jose Garcia-Rodriguez, et al. “LonchaNet: A Sliced-based CNN Architecture for Real-time 3D Object Recognition”. In: *2017 International Joint Conference on Neural Networks, IJCNN 2017, Anchorage, Alaska, May 14-19, 2017*. 2017. URL: <https://ieeexplore.ieee.org/document/7965883/>

1.4.2 Chapter 3

- Alberto Garcia-Garcia, Jose Garcia-Rodriguez, Sergio Orts-Escolano, et al. “A study of the effect of noise and occlusion on the accuracy of convolutional neural networks applied to 3D object recognition”. In: *Computer Vision and Image Understanding* 164 (2017), pp. 124–134. DOI: [10.1016/j.cviu.2017.06.006](https://doi.org/10.1016/j.cviu.2017.06.006). URL: <https://doi.org/10.1016/j.cviu.2017.06.006>
- Alberto Garcia-Garcia, Pablo Martinez-Gonzalez, Sergiu Oprea, et al. “The RobotriX: An eXtremely Photorealistic and Very-Large-Scale Indoor Dataset of Sequences with Robot Trajectories and Interactions”. In: *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. IEEE. 2018, pp. 6790–6797. URL: <https://ieeexplore.ieee.org/abstract/document/8594495>
- TODO: UnrealROX

1.4.3 Chapter 4

- TODO: TactileGCN

1.4.4 Other

During the years spent working on the main topics of this thesis, several collaborations and side works were carried out that also were published either as journal papers, conference proceedings, or preprints:

- Sergiu Oprea, Alberto Garcia-Garcia, Jose Garcia-Rodriguez, et al. “A Recurrent Neural Network based Schaeffer Gesture Recognition System”. In: *2017 International Joint Conference on Neural Networks, IJCNN 2017, Anchorage, Alaska, May 14-19, 2017*. 2017. URL: <https://ieeexplore.ieee.org/document/7965885/>

- Francisco Gomez-Donoso, Sergio Orts-Escolano, Alberto Garcia-Garcia, et al. "A robotic platform for customized and interactive rehabilitation of persons with disabilities". In: *Pattern Recognition Letters* 99 (2017), pp. 105–113. DOI: [10.1016/j.patrec.2017.05.027](https://doi.org/10.1016/j.patrec.2017.05.027). URL: <https://doi.org/10.1016/j.patrec.2017.05.027>
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- Sergio Orts-Escolano, Jose Garcia-Rodriguez, Miguel Cazorla, et al. "Bioinspired point cloud representation: 3D object tracking". In: *Neural Computing and Applications* 29 (2016), pp. 663–672. ISSN: 1433-3058. DOI: [10.1007/s00521-016-2585-0](https://doi.org/10.1007/s00521-016-2585-0). URL: <https://doi.org/10.1007/s00521-016-2585-0>
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- Sergio Orts-Escolano, Jose Garcia-Rodriguez, Jose Antonio Serra-Perez, et al. "3D model reconstruction using neural gas accelerated on GPU". in: *Applied Soft Computing* 32 (2014), pp. 87–100. DOI: [10.1016/j.asoc.2015.03.042](https://doi.org/10.1016/j.asoc.2015.03.042). URL: <http://dx.doi.org/10.1016/j.asoc.2015.03.042>

- TODO: ICP

1.5 Thesis Structure

Chapter 2

Object Recognition

2.1 Introduction

2.2 Related Works

2.2.1 2D Object Recognition

2.2.2 RGB-D Object Recognition

2.2.3 3D Object Recognition

2.3 PointNet

2.4 Noise and Occlusion

2.5 LonchaNet

2.6 Conclusion

Chapter 3

Semantic Segmentation

3.1 Introduction

3.2 Related Works

3.3 The RobotriX

3.4 UnrealROX

3.5 2D-3D-SeGCN

Chapter 4

Tactile Sensing

4.1 Introduction

4.2 Related Works

4.3 TactileGCN

4.4 Conclusion

Chapter 5

Conclusion

5.1 Findings and Conclusions

5.2 Limitations

5.3 Future Work

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- [1] Alberto Garcia-Garcia, Francisco Gomez-Donoso, Jose Garcia-Rodriguez, et al. "PointNet: A 3D Convolutional Neural Network for real-time object class recognition". In: *2016 International Joint Conference on Neural Networks, IJCNN 2016, Vancouver, BC, Canada, July 24-29, 2016*. 2016, pp. 1578–1584. DOI: [10.1109/IJCNN.2016.7727386](https://doi.org/10.1109/IJCNN.2016.7727386). URL: <https://doi.org/10.1109/IJCNN.2016.7727386>.
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