

Carlos Alberto Gomez Gonzalez

Post-doctoral researcher on Artificial Intelligence for Earth Sciences

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Education

PhD in Computer Vision and Astrophysics 2013-2017
STAR and Montefiore Institutes, Université de Liège, Belgium
Supervisors: Jean Surdej, Marc Van Droogenbroeck, Olivier Absil
Thesis: Advanced data processing for high-contrast imaging – pushing exoplanet direct detection limits with Machine Learning

MSc in Astrophysics 2012-2013
Universidad Autónoma de Madrid and Universidad Complutense, Spain

Specialization in Software Development 2011-2012
Universidad del Magdalena, Colombia

BSc in Astronomy and Astrophysics 2002-2007
VV Sobolev Astronomical Institute, St. Petersburg State University, Russia

Work experience

Post-doctoral researcher on Artificial Intelligence for Earth Sciences 2019-present
Barcelona Supercomputing Center, Barcelona, Spain

Junior research chair in Data Science 2017-2019
Grenoble Alpes Data Institute, Université Grenoble Alpes, France

Data science consultant March 2017
Science to Data Science program, Pivigo Ltd

Technician in Geographic Information Systems 2011-2012
IGAC – Agustín Codazzi Geographical Institute, Santa Marta, Colombia

Scientific advisor at Planetarium of Medellín 2009-2010
Planetarium “Jesus Emilio Ramírez González”, Medellín, Colombia

Junior researcher and lecturer for introductory Physics 2009-2010
Technological University ITM, Medellín, Colombia

Supervising and mentoring activities

Co-supervisor of student project on image processing and ML 2019
Monash University

Supervisor of end of studies internship on image processing and ML 2019
Université Grenoble Alpes

Co-supervisor of master thesis on image processing and ML 2018-2019
Université Grenoble Alpes

Co-supervisor of master thesis on image processing 2014-2015
Catholic University of Louvain

Funding received

Grant for project “Exoplanet direct imaging meets AI” (14 k€) 2018-2019
Grenoble Alpes Data Institute, France

Prizes and awards received

1st Prize at the InvEnterPrize competition with “Amigrow” farming team March 2019
Aberystwyth University, Wales, United Kingdom

1st Prize at the Phi-week startup bootcamp as part of the team “Amigrow” November 2018
European Space Agency, Earth Observation Phi-Week

PyData Amsterdam, diversity scholarship April 2017
Numfocus

PhD Scholarship under ARC grant for Concerted Research Action 2013-2017
Université de Liège, Belgium

Scholarship for master studies in Astrophysics 2012-2013
CSIC International Campus of Excellence & Universidad Autónoma de Madrid

Scholarship for studies in Astronomy 2001-2007
ICETEX (Colombia) & Government of the Russian Federation

Software development and scientific computing

- Six years of software development experience with Python.
- Large experience with Python scientific libraries: Numpy, Scipy, Pandas, Jupyter(lab), Astropy, Scikit-image, OpenCV, emcee, Dask, Matplotlib, Bokeh and Seaborn.
- Experience with ML/DL libraries: Scikit-learn, Keras, Tensorflow, Pytorch, H2O and Cupy.
- Experience in open-source collaborative development and version control with Git.
- Selected packages on [GitHub](#):
 - VIP: Astronomical image processing.
 - SODINN: Deep learning applied to supervised source detection in high-contrast imaging.
 - exoimaging_challenge_extras: Supporting code for the [Exoplanet Imaging Challenge](#).
 - PyAstrOFit: Planet orbit fitting using MCMC.
 - HCIplot: Plotting multidimensional high-contrast imaging datacubes.
- Documentation and tutorials generation with Sphinx, readthedocs and Jupyter notebooks.
- Continuous integration with Travis CI and automated testing with pytest.
- Experience with NLP libraries: NLTK and Spacy.
- Large experience with bash (Unix-based systems) and \LaTeX .
- Past experience with R, SQL, C, Fortran, Java, Octave/Matlab and HTML.
- Past experience with GIS platforms: ArcGIS and QGIS.

Languages

Spanish	Native
English	Advanced reading (C1), speaking (C1) and writing (C1)
Russian	Advanced reading (C1), intermediate speaking (B1) and writing (B1)
French	Intermediate reading (B2), basic speaking (B1) and writing (A2)

Conferences and events

Most of my talks are showcased on my [personal website](#) and my [Speaker deck](#) profile.

Invited talks:

- *Academic data science: reflections and lessons learned*, June 2019, Global Challenges Science Week, Grenoble, France.
- *Exoplanet imaging data challenge*, June 2019, Global Challenges Science Week, Grenoble, France.
- *A data scientist's guide to direct imaging of exoplanets*, February 2019, RADA Big data workshop, Medellin, Colombia.
- *Supervised detection of exoplanets with deep neural networks*, August 2018, Université de Liège - Colonster castle, Liège, Belgium.
- *Review of mainstream post-processing techniques for high-contrast imaging*, August 2018, Université de Liège - Colonster castle, Liège, Belgium.
- *Python for scientific computing. Git and GitHub for collaborative software development*, May 2018, Grenoble Alpes Data Institute, Grenoble, France.
- *Data science in astronomical image processing: looking for exoplanets using supervised machine learning*, March 2018, Data Science in the Alps, Grenoble, France.
- *High-contrast imaging post-processing methods for exoplanet detection and characterization*, February 2018, Seminar Thoth team, INRIA Grenoble - Rhône-Alpes, France.
- *Post-processing for high-contrast imaging*, August 2016, Keck Institute for Space Studies (KISS) workshop on Direct Imaging of exoplanets, Caltech, US.
- *Applications of PCA and low-rank plus sparse decompositions in high-contrast Exoplanet imaging*, February 2016, Seminar ICTEAM, Catholic University of Louvain, Belgium.

Contributed talks:

- *Deep (learning) dive on SPHERE/IRDIS image processing*, October 2018, Centrum Wiskunde & Informatica, Amsterdam, Netherlands.
- *A la caza de exoplanetas por imagen directa con Python: De la ciencia de datos, la exoplanetología y otros demonios*, October 2018, PyconES, Málaga, Spain.
- *Exoplanet direct imaging meets data science*, June 2018, NASA ARC Space Science and Astrobiology Division Seminar Series, Silicon Valley, US.
- *Exoplanet direct imaging meets data science*, June 2018, Kavli Institute for Particle Astrophysics and Cosmology, Stanford, US.
- *VIP & SODINN - Python packages for exoplanets direct imaging*, May 2018, Python in Astronomy, New York, US.
- *Data science for direct imaging of exoplanets. Machine learning applied to high-contrast imaging*, April 2018, European Week of Astronomy and Space Science, Liverpool, UK.
- *Academic data science: conducting research at the interface of different disciplines*, February 2018, Data club seminar, Université Grenoble Alpes, France.
- *Supervised detection of exoplanets through high-contrast imaging*, August 2017, Workshop on Image processing for high-contrast imaging, Université de Liège, Belgium.
- *Deep machine learning for astronomical image processing and signal detection*, July 2017, Seminar IPAG, Université Grenoble Alpes, France.
- *Image-processing for high-contrast imaging. Beyond the black-box*, January 2017, Seminar, ETH Zurich, Switzerland.
- *Post-processing for high-contrast imaging*, August 2016, Keck Institute for Space Studies (KISS) workshop on direct imaging of exoplanets, Caltech, US.
- *Angular and reference star differential imaging post-processing*, August 2016, First Vortex international workshop, Caltech, US.

- *Beyond PCA, Low-rank plus Sparse decomposition of high-contrast ADI image sequences for exoplanet detection*, June 2015, In the Spirit of Lyot conference, Montreal, Canada.
- *Vortex Image Processing package tutorial*, May 2015, Adaptive optics data processing workshop, Laboratoire d'Astrophysique de Marseille (LAM), France.

Organisation of events:

- Lead organizer of the [Exoplanet Imaging Challenge](#). Astronomical Data Challenge launched on Codalab, 2019.
- Co-organizer of the Python for science and data analysis day. Workshop organized at the Université Grenoble Alpes, 2018.

Participation to other events:

- ESA Living Planet Symposium, May 2019, Milan, Italy.
- ESA Earth observation Phi-week, November 2018, Frascati, Italy.
- PRAIRIE Artificial Intelligence Summer School, July 2018, Grenoble, France.
- Combining high-resolution spectroscopy and high-contrast imaging, June 2018, Pasadena, US.
- NUMEDIART Deep Learning workshop, May 2017, Mons, Belgium.
- PyData Amsterdam, April 2017, Netherlands.
- PyData Berlin, May 2016, Germany.
- ONERA high-contrast imaging workshop, January 2015, Chatillon, France.
- Sagan Exoplanet Summer Workshop, July 2014, Pasadena, US.
- 5th Subaru International Conference – Exoplanets and disks, December 2013, Hawaii, US.

Publications

In peer-reviewed scientific journals::

- [1] **C. A. Gomez Gonzalez**, D. Mouillet, and O. Absil. SODINN framework for deep learning applied to supervised exoplanet direct detection in high-contrast imaging. *in prep.*, 2019.
- [2] G. Ruane, H. Ngo, D. Mawet, et al. Reference Star Differential Imaging of Close-in Companions and Circumstellar Disks with the NIRC2 Vortex Coronagraph at the W. M. Keck Observatory. *Astronomical Journal*, 157:118, Mar 2019.
- [3] A. M. Lagrange, A. Boccaletti, M. Langlois, et al. Post-conjunction detection of β Pictoris b with VLT/SPHERE. *Astronomy and Astrophysics*, 621:L8, Jan 2019.
- [4] D. Mawet, L. Hirsch, E. J. Lee, et al. Deep Exploration of ϵ Eridani with Keck Ms-band Vortex Coronagraphy and Radial Velocities: Mass and Orbital Parameters of the Giant Exoplanet. *Astronomical Journal*, 157:33, Jan 2019.
- [5] B. Pairet, F. Cantalloube, **C. A. Gomez Gonzalez**, O. Absil, and L. Jacques. STIM map: detection map for exoplanets imaging beyond asymptotic Gaussian residual speckle noise. *ArXiv e-prints*, October 2018.
- [6] W. Jerry Xuan, Dimitri Mawet, Henry Ngo, et al. Characterizing the Performance of the NIRC2 Vortex Coronagraph at W. M. Keck Observatory. *Astronomical Journal*, 156:156, Oct 2018.
- [7] V. Christiaens, S. Casassus, O. Absil, et al. Characterization of low-mass companion HD 142527 B. *Astronomy and Astrophysics*, 617:A37, Sep 2018.
- [8] **C. A. Gomez Gonzalez**, O. Absil, and M. van Droogenbroeck. Supervised detection of exoplanets in high-contrast imaging sequences. *Astronomy and Astrophysics*, 613:A71, May 2018.
- [9] M. Reggiani, V. Christiaens, O. Absil, et al. Discovery of a point-like source and a third spiral arm in the transition disk around the Herbig Ae star MWC 758. *Astronomy and Astrophysics*, 611:A74, Mar 2018.

- [10] G. Ruane, D. Mawet, J. Kastner, et al. Deep Imaging Search for Planets Forming in the TW Hya Protoplanetary Disk with the Keck/NIRC2 Vortex Coronagraph. *Astronomical Journal*, 154:73, August 2017.
- [11] R. Jensen-Clem, D. Mawet, **C. A. Gomez Gonzalez**, et al. A New Standard for Assessing the Performance of High Contrast Imaging Systems. *Astronomical Journal*, 155:19, Jan 2018.
- [12] **C. A. Gomez Gonzalez**, O. Wertz, O. Absil, et al. VIP: Vortex Image Processing Package for High-contrast Direct Imaging. *Astronomical Journal*, 154:7, July 2017.
- [13] Z. Wahhaj, J. Milli, G. Kennedy, et al. The SHARDDS survey: First resolved image of the HD 114082 debris disk in the Lower Centaurus Crux with SPHERE. *Astronomy and Astrophysics*, 596:L4, November 2016.
- [14] É. Choquet, J. Milli, Z. Wahhaj, et al. First Scattered-light Images of the Gas-rich Debris Disk around 49 Ceti. *Astrophysical Journal, Letters*, 834:L12, January 2017.
- [15] V. Christiaens, S. Casassus, O. Absil, et al. Characterization of the low-mass companion HD 142527 B. *Under review, submitted to A&A*.
- [16] J. Milli, P. Hibon, V. Christiaens, et al. Discovery of a low-mass companion inside the debris ring surrounding the F5V star HD 206893. *Astronomy and Astrophysics*, 597:L2, January 2017.
- [17] E. Serabyn, E. Huby, K. Matthews, et al. The W. M. Keck Observatory Infrared Vortex Coronagraph and a First Image of HIP 79124 B. *Astronomical Journal*, 153:43, January 2017.
- [18] D. Mawet, É. Choquet, O. Absil, et al. Characterization of the Inner Disk around HD 141569 A from Keck/NIRC2 L-Band Vortex Coronagraphy. *Astronomical Journal*, 153:44, January 2017.
- [19] O. Wertz, O. Absil, **C. A. Gomez Gonzalez**, et al. VLT/SPHERE robust astrometry of the HR8799 planets at milliarcsecond-level accuracy. Orbital architecture analysis with PyAstrOFit. *Astronomy and Astrophysics*, 598:A83, February 2017.
- [20] **C. A. Gomez Gonzalez**, O. Absil, P.-A. Absil, et al. Low-rank plus sparse decomposition for exoplanet detection in direct-imaging ADI sequences. The LLSG algorithm. *Astronomy and Astrophysics*, 589:A54, April 2016.
- [21] F. Cantalloube, D. Mouillet, L. M. Mugnier, et al. Direct exoplanet detection and characterization using the ANDROMEDA method: Performance on VLT/NaCo data. *Astronomy and Astrophysics*, 582:A89, October 2015.
- [22] V. A. Hagen-Thorn, N. V. Efimova, V. M. Larionov, et al. Color variations of the blazar 3C 454.3 in 2004-2006. *Astronomy Reports*, 53:510–518, June 2009.
- [23] C. M. Raiteri, M. Villata, V. M. Larionov, et al. WEBT and XMM-Newton observations of 3C 454.3 during the post-outburst phase. Detection of the little and big blue bumps. *Astronomy and Astrophysics*, 473:819–827, October 2007.

Non Refereed:

- [1] O. Absil, D. Mawet, M. Karlsson, et al. Three years of harvest with the vector vortex coronagraph in the thermal infrared, in *Ground-based and Airborne Instrumentation for Astronomy VI*, vol. 9908 of *Proceedings of the International Society for Optical Engineering*, Aug. 2016, p. 99080Q.
- [2] B. Femenía Castellá, E. Serabyn, D. Mawet, et al. Commissioning and first light results of an L'-band vortex coronagraph with the Keck II adaptive optics NIRC2 science instrument, *Adaptive Optics Systems V*, 2016.
- [3] B. Pairet, L. Jacques, **C. A. Gomez Gonzalez**, et al. Low Rank and Group-Average Sparsity Driven Convex Optimization for Direct Exoplanets Imaging, in *Third international Traveling Workshop on Interactions between Sparse models and Technology*, 2016.

- [4] D. Defrère, O. Absil, P. Hinz, et al. L'-band AGPM vector vortex coronagraph's first light on LBT/LMIRCam, in *Adaptive Optics Systems IV*, vol. 9148 of *Proceedings of the International Society for Optical Engineering*, July 2014, p. 91483X.