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Email address corresponding author: g.a.verdoes.kleijn@rug.nl

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**Machine Learning assisted NEO Discovery and Polarimetric Characterization
with Astronomical Surveys**

**G.A. Verdoes Kleijn⁽¹⁾, T. Grobler⁽²⁾, S.J. Chong^(1,2), O.R. Williams⁽¹⁾, M. Micheli⁽³⁾,
D. Koschny^(4,5), T. Saifollahi⁽⁶⁾, L.V.E. Koopmans⁽¹⁾, D. Dirkx⁽⁷⁾, T. Santana-Ros^(8,9)**

⁽¹⁾ University of Groningen, postbus 800, 9700 AV, Groningen, The Netherlands

⁽²⁾ Stellenbosch University, Private Bag X1, 7602 Matieland, South Africa

⁽³⁾ ESA Near-Earth Object Coordination Centre, ESRIN, Largo Galileo Galilei 1
00044, Frascati (Rome), Italy

⁽⁴⁾ Lunar and Planetary Exploration, LPE/TUM, Lise-Meitner-Str. 9
85521, Ottobrun, Germany

⁽⁵⁾ Space Exploration Institute (SPACE-X), Fbg de l'Hôpital 68, 2000 Neuchâtel, Switzerland

⁽⁶⁾ Observatoire Astronomique de Strasbourg, 11 Rue de l'Université, 67000 Strasbourg, France.

⁽⁷⁾ Delft University of Technology, Mekelweg 5, 2628 CD, Delft, The Netherlands.

⁽⁸⁾ Universidad de Alicante, Carr. de San Vicente del Raspeig, s/n, 03690 San Vicente del Raspeig,
Alicante, Spain

⁽⁹⁾ Universitat de Barcelona, Carrer de Martí i Franquès, 1, 08028 Barcelona, Spain

Email addresses: g.a.verdoes.kleijn@rug.nl, tgrobler@sun.ac.za, soonjiec@gmail.com,
o.r.williams@rug.nl, Marco.Micheli@ext.esa.int, detlef.koschny@tum.de, teymur.saif@gmail.com,
koopmans@astro.rug.nl, D.DirIx@tudelft.nl, tonisantanos@gmail.com

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We are part of an expertise group of over two dozen astronomers, computer scientists, data scientists and digital Big Data research platform experts at 11 universities and research institutes in South Africa and Europe. We study Near-Earth Objects (NEOs) for Planetary Defence and scientific purposes.

NEO Discovery. In this talk, we present our programme and results for algorithms and digital data analysis platforms for machine learning-assisted Near-Earth Object discovery, monitoring, and polarimetric characterisation in astronomical surveys for Planetary Defence and scientific purposes.

We present the performance of detecting streak-like features in large astronomical surveys using classical and machine learning methods, focusing on Near-Earth Objects. Our current focus is ESA's Euclid Survey, Rubin's Legacy Survey of Space and Time, and surveys with INAF's VLT Survey Telescope. We present results using Convolutional Neural Networks (CNNs) in comparison to classical methods (e.g., SourceXtractor, StreakDet). We present our preliminary assessment comparing Vision Transformers and CNNs.

NEO Characterization. The VLT Survey Telescope's polarimetric survey mode will be commissioned in 2026. We present our first analysis of polarimetry's value for NEO Planetary Defence and science and the potential of machine learning applications in NEO polarimetry.

NEO Digital Platforms. We present the challenges experienced in our digital Big Data research platforms to perform machine learning-assisted Near-Earth Object discovery and monitoring in astronomical surveys. We have a leading role in digital Big Data platforms for ESA ([Euclid Mission](#)¹) and for ESO instrumentation ([VST-OmegaCAM](#), [VLT-MUSE](#), [ELT-MICADO](#)²/[METIS](#)). These platforms build on our [AstroWISE](#) Information System, which was developed for astronomical research. Our NEO discovery, astrometric, and photometric monitoring use these platforms and their massive data archives, compute clusters, and databasing.

In this talk, we describe the lessons learned from taking this piggybacking approach. The synergies between NEO investigations and astronomical science lie in (i) common instrument and software requirements on astrometric and photometric precision calibration and (ii) common requirements on databasing and IT to handle such large datasets. The challenges lie in bridging the gap between communities and the sometimes non-natural fit with the traditional tasks of universities and science funding agencies. We conclude the presentation by giving an outlook on how to strengthen the synergies and overcome the challenges. This includes future plans to link the astronomical databases to the [open-source Tudat](#) orbit estimation software for automated ephemeris updates of target NEOs, and dynamical validation of new observations.

List of relevant publications involving our team: Astrophysics Data System [NEO Planetary Defense library](#)

¹ see also [Euclid Netherlands Science Data Center](#)

² see also [MICADOWise.org](#)