

Artificial Intelligence for **Earth Observation** (AI4EO): Reasoning, Uncertainties, Ethics and Beyond.



In 2020, the IEAI became part of a 5 million BMBF grant for the newly established Future Lab Artificial intelligence for Earth Observation (AI4EO). Led by the Technical University of Munich in cooperation with the German Aerospace Center, the Lab brings 20 renowned international organizations across nine countries and 27 highly ranked scientists at all levels together to address three fundamental challenges in EO-specific cutting-edge artificial intelligence research – Reasoning, Uncertainties, and Ethics.

The goal of the ethics segment of the AI4EO Future Lab is to support ethically mindful research and decision making by scientists at the very early stages of AI4EO research. Combining structured (ethics) research and unstructured/semi-structured interactions with other scientists working in the field of AI4EO, the aim is to create a practical approach through which scientists can (self) analyze their research through an ethical lens. The research includes studying whether existing (dominant) Western ethical theories and Eastern philosophical/ethical thought are adequate to devise such an approach, particularly in the light of uncertainties that dominate the rapidly expanding field of AI4EO.

Initial interactions and surveys conducted with AI4EO scientists revealed that

- ▶ although more than 40% of the scientists/researchers stated that they have read one or more major AI ethics guidelines, 90% found these guidelines to be practically not useful for their daily work and research.
- ▶ yet, AI and ML models are becoming increasingly relevant in EO research as the quantity of data available for research increases, and more (including unconventional) sources of data are fused with EO/RS data.
- ▶ many early-stage researchers are aware of well-known issues such as privacy, but are not aware of how to effectively and comprehensively manage privacy concerns. They are also unaware of any method or approach that can help them identify ethical concerns (and opportunities) at any stage of their research.
- ▶ ethical concerns linked with AI4EO research remain largely unknown. Nonetheless, ethical issues are likely to come to light at much later stages of R&D. Accordingly, adoption of existing/known ethical theories (based either on duty, consequences or a combination thereof) and guidelines may not be adequate to help scientists identify, flag and address ethical issues in early stages of research, before it is too late.

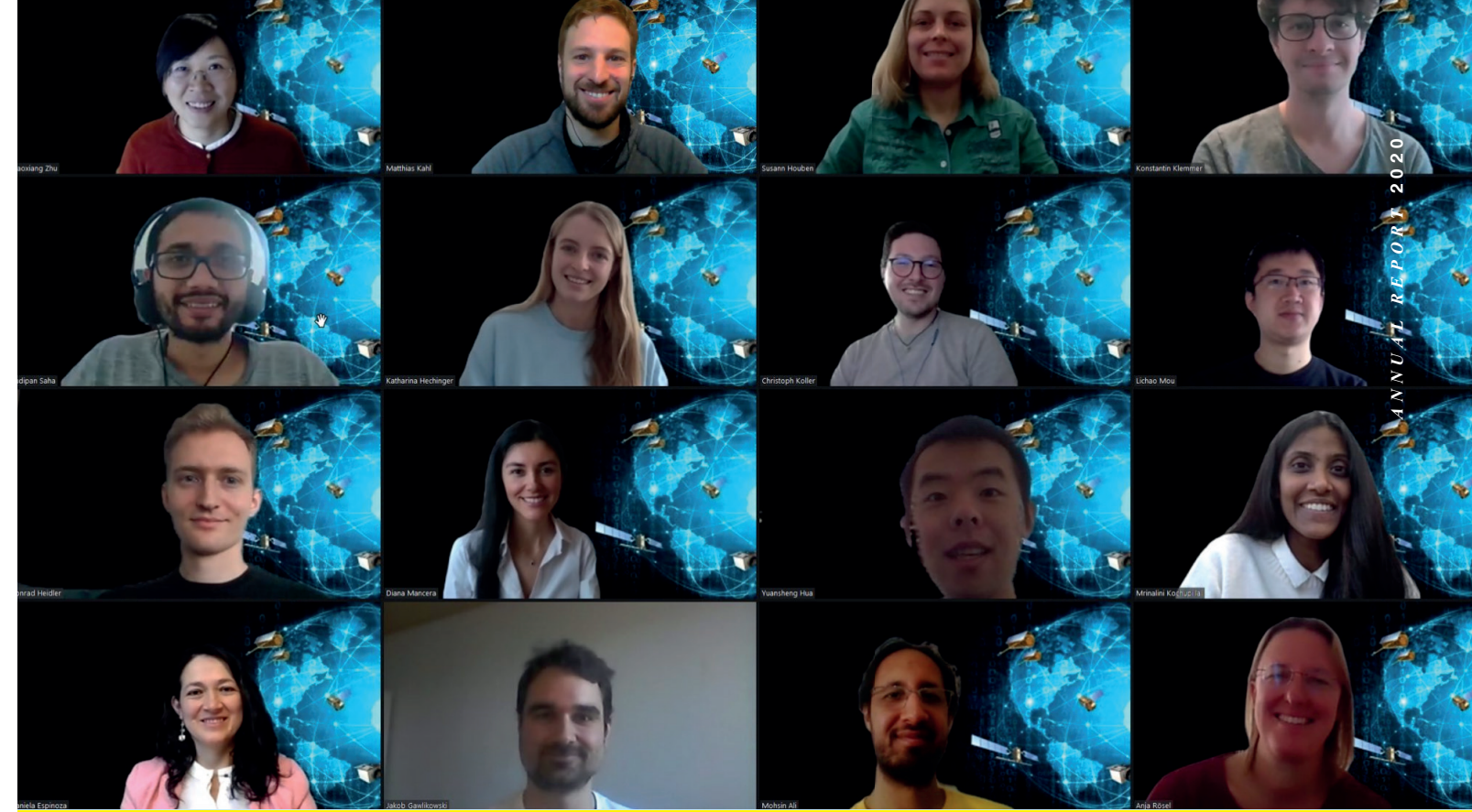
The research used preliminary inputs and feedback from various AI4EO scientists to create an initial outline of a novel approach and matrix for identifying ethical concerns that may arise or need attention at various stages of a typical AI4EO research and data lifecycle. Using a unique iterative methodology, this initial outline is now being continuously improved and its practical utility and applicability checked vis-à-vis various AI4EO research “cases”. This is done by using, testing and evaluating the matrix with inputs from AI4EO researchers/scientists at various research and career stages.

The research approach is adopted keeping the uncertain future and rapid technological progress in the AI4EO research sphere in mind. Therefore, the categories informing the matrix, as well as the ethical issues populating it, are not set in stone. Instead, an open-ended and introspective questionnaire guides the constant evolution and customization of the matrix for diverse research sub-fields and analytical methods. The ethics matrix for AI4EO research is not aimed at narrowing research innovativeness and freedom, but rather at supporting the development of ethics-oriented thinking amongst scientists already at early stages of their career.

Plans for 2021

In the light of the fact that not all ethical issues can be addressed by technological solutions, it is necessary to develop training and educational curriculums for scientists to support mindfulness and associated ethical decision making. For this, multi-disciplinary research engaging experts from human cognitive and brain sciences is planned going forward. Utilizing the “beyond fellows” program of AI4EO for this purpose, evidence-based techniques known to enhance mindfulness will be studied through appropriate experimental and other approaches to determine if they also support ethically mindful research and decision making among scientists at various stages of their academic career.

The practical approach and training curriculum, it is hoped, will serve as “ethics orientation” for AI in Earth Observation in the future, particularly in the context of ensuring human dignity and supporting welfare-oriented human creativity and innovation. This includes freedom of choice and privacy on the one hand, and human values and responsibility to adequately ensure safety, as well as the continuation of beneficial innovation in the field of AI4EO, on the other. ●



2020 Paper Highlights

- ▶ Programming Away Human Rights and Responsibilities? “The Moral Machine Experiment” and the Need for a More “Humane” AV Future, NanoEthics (Kochupillai, M., Lütge, C, Poszler, F.)
- ▶ Law, Business and Legitimacy. Rendtorff, J.D. (Ed.), Handbook of Business Legitimacy: Responsibility, Ethics and Society, Springer-Nature (Brinkmann, J., Kochupillai, M.)
- ▶ Incentivizing Research & Innovation with Agrobiodiversity Conserved In Situ: Possibilities and Limitations of a Blockchain-Based Solution, Journal of Cleaner Production (under review) (Kochupillai, M. et al.)
- ▶ Outline of a Novel Approach and Matrix for Identifying Ethical Issues in Early Stages of AI4EO Research, IEEE IGARSS Symposium (under review) (Kochupillai, M.)

2020 Conferences

- ▶ From Application-Agnostic to Application-Oriented AI4EO: Overview of ethical caveats and opportunities, Keynote Talk at Munich Aerospace, July 2020
- ▶ Literature Review of Ethical Issues in AI4EO: Current Understanding and Scope for Improvement, AI4EO Lab Talk at Munich AI Future Lab, Technical University of Munich, November 2020
- ▶ Ethics and AI Enabled Decision Making: Towards more affirmative-action and “care” oriented data labelling, The Responsible AI Forum (TRAI) Preview 2020, November 2020
- ▶ Mindfulness, Mental Health and Ethical Decision Making in Times of Uncertainty, the Art of Living Germany, November 2020.

Principal Investigators

- ▶ Prof. Dr. Xiaoxiang Zhu, Department of Aerospace and Geodesy, TUM

Research Partners

- ▶ Prof. Dr. Richard Hans Georg Bamler, The Remote Sensing Technology Institute, DLR
- ▶ Prof. Dr. Massimo Fornasier, Department of Mathematics, TUM
- ▶ Dr. Mrinalini Kochupillai, Professorship for Signal Processing in Earth Observation, TUM
- ▶ Prof. Dr. Christoph Lütge, TUM School of Governance