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Hossein Shirali

Ph.D. Researcher

Summary

Ph.D. researcher at the Karlsruhe Institute of Technology (KIT) specializing in computer vision and deep learning for biodiversity research. I design and deploy AI-powered systems for automated insect digitization, species identification, and biomass estimation, with proven integration into robotic instrumentation including the DiversityScanner and Entomoscope photomicroscope. My work bridges academic research and applied development—from model architecture design and scalable data pipelines to production-ready, open-source solutions—delivering robust tools that advance forest health assessment and large-scale ecological analysis.

Education

Ph.D. Candidate
Karlsruhe Institute of Technology (KIT) — Present, Karlsruhe, Germany
Fields of Study: Biodiversity Research Of Invertebrates Using Deep Learning Methods

Master of Electronic Technologies for BIG DATA and Internet Of Things
University of Bologna — Grade: 110 out of 110. — October 2021, Bologna, Italy
Fields of Study: Statistics and Architectures for Big Data Processing and Communications, Signal Acquisition and Processing.

Bachelor of Electronic Engineering
Shahid Chamran University of Ahvaz — 2017, Iran
Fields of Study: Computer Architecture, Digital system, Electronics

Experience

Doctoral Researcher
March 2023 - Present, Karlsruhe

Karlsruhe Institute of Technology

- Lead AI development for the Entomoscope photomicroscope and contribute to the DiversityScanner robotic ecosystem, enabling high-throughput automated insect digitization and analysis.
- Design and implement end-to-end deep learning pipelines for species identification, sex classification, orientation detection, and anatomical segmentation of morphologically challenging dark taxa from robotic imaging systems.
- Develop InsectMorphoAI, an image-based software suite for automated estimation of insect length, volume, and biomass from 2D images, supporting large-scale ecological assessment.
- Contribute to EU Horizon Europe project FORSAID (Forest Surveillance with Artificial Intelligence and Digital Technologies, Grant No. 101134200) within WP3 "Digital technologies for ground detection and surveillance of regulated pests," building deep learning classifiers for regulated forest pest species identification from trap images.
- Collaborate with interdisciplinary teams of engineers, taxonomists, and ecologists to integrate AI workflows into production-ready robotic devices, transitioning systems from prototype to deployment in biodiversity monitoring and forest health surveillance.

Data Scientist Consultant February 2022 - March 2023, Remote

Modis / Baker Hughes

- Developed an optimization algorithm to improve turbine maintenance efficiency.
- Led a cloud data migration project and implemented enhanced data security protocols.
- Designed automation tools using Microsoft Power Platform and conducted internal training sessions for O365 tools.

Junior Data Scientist February 2021 - October 2021, Bologna , Italy

Plasive Technologies

- Designed and trained CNN-based models for semantic segmentation of satellite imagery.
- Developed an innovative carbon stock estimation method using remote sensing and data analytics.
- Constructed a comprehensive multi-dimensional dataset to support advanced satellite image research.

Machine Learning Intern

Kiwitron September 2020 - January 2021, Bologna, Italy

- Developed a semi-automatic image labeling method using point cloud data as a master thesis.
- Achieved state-of-the-art performance in image annotation tasks.

Publications

Peer-Reviewed Journal Articles:

- **Shirali, H.**, Hübner, J. J., Both, R., Raupach, M. J., Reischl, M., Schmidt, S., & Pylatiuk, C. (2024). Image-based recognition of parasitoid wasps using advanced neural networks. Invertebrate Systematics, 38(6), IS24011. https://doi.org/10.1071/IS24011

- Wührl, L., Keller, L., Klug, N., **Shirali, H.**, Meier, R., & Pylatiuk, C. (2024). Automated handling of biological objects with a flexible gripper for biodiversity research. Automatisierungstechnik, 72(7), 672–678. https://doi.org/10.1515/auto-2023-0238

Preprints & Manuscripts:

- **Shirali, H.**, Wuehrl, L., Lee, L., Klug, N., Meier, R., Pylatiuk, C., & Hartop, E. A. (2025). Automated specimen triage for dark taxa: Deep learning enables orientation, sex identification, and anatomical segmentation from robotic imaging. bioRxiv. https://doi.org/10.1101/2025.10.02.680063

- **Shirali, H.**, Ascenzi, A., Wuehrl, L., Beyer, N., Di Lorenzo, N., Vaccarella, E., Klug, N., Meier, R., Cerretti, P., & Pylatiuk, C. (2025). InsectMorphoAI: Deep learning-based methods for automated estimation of insect length, volume, and biomass. bioRxiv. https://doi.org/10.1101/2025.05.22.655251

- Caruso, V., **Shirali, H.**, Bouget, C., Curletti, G., de Groot, M., Groznik, E., Gutowski, J. M., Pylatiuk, C., Roques, A., Sallé, A., Sweeney, J., Wuehrl, L., & Rassati, D. (2025). Image-based recognition using advanced neural networks can aid surveillance of Agrilus (Coleoptera, Buprestidae) jewel beetles. ARPHA Preprints. https://doi.org/10.3897/arphapreprints.e154842

- Saur, L., von Pawlowski, M., Gengenbach, U., Sieber, I., **Shirali, H.**, Wuehrl, L., Kiko, R., & Pylatiuk, C. (2025). Classification of microplastic particles in water using polarized light scattering and machine learning methods. arXiv preprint. https://doi.org/10.48550/arXiv.2511.06901

- Klug, N., Kramer, M., Mazrek, F., Wuehrl, L., **Shirali, H.**, Meier, R., & Pylatiuk, C. (2024). Automated photogrammetric close-range imaging system for small invertebrates using acoustic levitation. TechRxiv preprint. https://doi.org/10.36227/techrxiv.172651022.21831566

In Preparation:

- **Shirali, H.**, Wuehrl, L., Klug, N., Meier, R., & Pylatiuk, C. (in preparation). Entomoscope 2.0: A low-cost, AI-powered, open-source photomicroscope for automated insect digitization and morphometric analysis. Manuscript in preparation.

Conferences & Presentations

Entomology Congress (DGaaE 2025), Geisenheim, Germany

- Presentation: “AI-driven advances in Species Identification and Biomass Analysis”

27th International Congress of Entomology (ICE 2024), Kyoto, Japan

- Presentation: “AI as a Catalyst in Entomological Research by Simplifying Species Identification”

Helmholtz Artificial Intelligence Conference (Helmholtz AI 2024), Düsseldorf, Germany

- Poster Presentation: “Advancing Biodiversity Research with AI-Driven Automation”

Helmholtz Imaging Conference (2023), Hamburg, Germany

- Poster Presentation: “Automated Biodiversity Research”

Skills

Technical Skills:

Python | scikit-learn | TensorFlow | Keras | PyTorch | ONNX | OpenCV | YOLO

Docker | Kubernetes | Git | CI/CD | AWS | HPC/SLURM | Streamlit | Gradio | VS Code | Jupyter

Expertise:

Deep Learning | Computer Vision | Model Deployment | Data & Image Analysis | Neural Network Design | Scientific Computing | Robotic Imaging Integration

Languages:

English (B2) | German (A2) | Persian (native)

Refrences

Prof. Dr. Christian Pylatiuk
Institute for Automation and Applied Informatics (IAI)
Group Leader Biomedical Engineering & Robotics
Karlsruhe Institute of Technology (KIT)
Email: christian.pylatiuk@kit.edu

Prof. Dr. Rudolf Meier
Head of the Center for Integrative Biodiversity Discovery
Museum für Naturkunde Berlin
and Professor at Humboldt University zu Berlin
Email: rudolf.meier@mfn.berlin