Benjamin Alt

Curriculum Vitae

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Born: September 16, 1993—Karlsruhe, Germany
Nationality: German

Current Position

Senior Team Lead Research, ArtiMinds Robotics, Karlsruhe, Germany

Areas of Specialisation

Artificial Intelligence, Cognitive Robotics, AI Safety, Human-AI Interaction

Education

2020-2025	Ph.D. Computer Science Institute for Artificial Intelligence, University of Bremen, Germany Dissertation: *Neurosymbolic Robot Programming: A Framework for AI-Enabled Programming of Robot Manipulation Tasks*
2017-2019	M.Sc. Computer Science Institute for Anthropomatics and Robotics, Karlsruhe Institute of Technology, Germany
2015-2017	B.Sc. Computer Science Institute for Anthropomatics and Robotics, Karlsruhe Institute of Technology, Germany
2012-2015	B.A. Political Science Institut d'Études Politiques de Paris, France and Princeton University, NJ, USA

Professional Experience

2024-	Senior Team Lead Research, ArtiMinds Robotics, Karlsruhe, Germany
2023-2024	Senior Research Scientist, ArtiMinds Robotics, Karlsruhe, Germany
2019-2022	Research Scientist, ArtiMinds Robotics, Karlsruhe, Germany
2017-2019	Junior Software Engineer, ArtiMinds Robotics, Karlsruhe, Germany
2016-2017	Student Engineer, ArtiMinds Robotics, Karlsruhe, Germany
2015-2016	Student Engineer, WIBU Systems AG, Karlsruhe, Germany

Publications

Book Chapters

2022 — L. Kluy, L. Kölmel, B. Alt, M. Baumgartner, B. Deml, L. Hornung, D. Katic, S. Kinkel, T. Kopp, M. Lorenz, P. Nicolai, N. Riedel, A. Schäfer, and C. Wurll, "Mensch-Roboter-Kollaboration in KMU – Potenziale identifizieren, analysieren und realisieren," in *Digitalisierung der Arbeitswelt im Mittelstand 1: Ergebnisse und Best Practice des BMBF-Forschungsschwerpunkts "Zukunft der Arbeit: Mittelstand – innovativ und sozial"*, V. Nitsch, C. Brandl, R. Häußling, J. Lemm, T. Gries, and B. Schmenk, Eds., Berlin, Heidelberg: Springer, 2022, pp. 55–97, ISBN: 978-3-662-64803-2. DOI: 10.1007/978-3-662-64803-2_3.

2020 — B. Graf, F. Jordan, G. Blume, R. Martin, M. Abdel-Keream, P. Mania, F. Gronbach, C. Emmerich, R. Schaller, D. Katic, and B. Alt, "RoPHa - Robuste Wahrnehmungsfähigkeiten für Roboter zur Unterstützung älterer Nutzer im häuslichen Umfeld," in *Autonome Roboter Für Assistenzfunktionen*, Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, 2020, pp. 118–133.

Refereed Journal Articles

2024 — A. Schultheis, B. Alt, S. Bast, A. Guldner, D. Jilg, D. Katic, J. Mundorf, T. Schlagenhauf, S. Weber, R. Bergmann, S. Bergweiler, L. Creutz, G. Dartmann, L. Malburg, S. Naumann, M. Rezapour, and M. Ruskowski, "EASY: Energy-Efficient Analysis and Control Processes in the Dynamic Edge-Cloud Continuum for Industrial Manufacturing," *KI - Künstliche Intelligenz*, Sep. 2024, ISSN: 1610-1987. DOI: 10.1007/s13218-024-00868-3.

Conference Proceedings

2024 — B. Alt, J. Dvorak, D. Katic, R. Jäkel, M. Beetz, and G. Lanza, "BANSAI: Towards Bridging the AI Adoption Gap in Industrial Robotics with Neurosymbolic Programming," in *Procedia CIRP*, vol. 130, Póvoa de Varzim, Portugal: Elsevier B.V., Jan. 2024, pp. 532–537. DOI: 10.1016/j.procir.2024.10.125. arXiv: 2404.13652 [cs].

B. Alt, U. Keßner, A. Taranovic, D. Katic, A. Hermann, R. Jäkel, and G. Neumann, "Domain-Specific Fine-Tuning of Large Language Models for Interactive Robot Programming," in *European Robotics Forum 2024*, ser. Springer Proceedings in Advanced Robotics, Rimini, Italy: Springer Nature, Mar. 2024, ISBN: 978-3-031-76428-8. arXiv: 2312.13905 [cs].

B. Alt, J. Zahn, C. Kienle, J. Dvorak, M. May, D. Katic, R. Jäkel, T. Kopp, M. Beetz, and G. Lanza, "Human-AI Interaction in Industrial Robotics: Design and Empirical Evaluation of a User Interface for Explainable AI-Based Robot Program Optimization," in *Procedia CIRP*, vol. 130, Póvoa de Varzim, Portugal: Elsevier B.V., Apr. 2024, pp. 591–596. DOI: 10.1016/j.procir.2024.10.134. arXiv: 2404.19349 [cs].

B. Alt, F. Stöckl, S. Müller, C. Braun, J. Raible, S. Alhasan, O. Rettig, L. Ringle, D. Katic, R. Jäkel, M. Beetz, M. Strand, and M. F. Huber, "RoboGrind: Intuitive and Interactive Surface Treatment with Industrial Robots," in *2024 IEEE International Conference on Robotics and Automation (ICRA)*, Yokohama, Japan: IEEE, May 2024, ISBN: 979-8-3503-8457-4. DOI: 10.1109/ICRA57147.2024.10611143. arXiv: 2402.16542 [cs].

C. Kienle, B. Alt, O. Celik, P. Becker, D. Katic, R. Jäkel, and G. Neumann, "MuTT: A Multimodal Trajectory Transformer for Robot Skills," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Abu Dhabi: IEEE, Aug. 2024. DOI: 10.48550/arXiv.2407.15660. arXiv: 2407.15660 [cs].

2023   B. Alt, M. D. Nguyen, A. Hermann, D. Katic, R. Jäkel, R. Dillmann, and E. Sax, "EfficientPPS: Part-aware Panoptic Segmentation of Transparent Objects for Robotic Manipulation," in *ISR Europe 2023*, Stuttgart, Germany: VDE Verlag, Sep. 2023, ISBN: 978-3-8007-6140-1.

B. Alt, F. K. Kenfack, A. Haidu, D. Katic, R. Jäkel, and M. Beetz, "Knowledge-Driven Robot Program Synthesis from Human VR Demonstrations," in *Proceedings of the 20th International Conference on Principles of Knowledge Representation and Reasoning*, Rhodes, Greece: IJCAI, Sep. 2023, pp. 34–43, ISBN: 978-1-956792-02-7. DOI: 10.24963/kr.2023/4.

J. Raible, O. Rettig, B. Alt, A. Yaman, I. Gauger, L. Biasi, S. Müller, D. Katic, M. Strand, and M. F. Huber, "Artificial Neural Network Guided Compensation of Nonlinear Payload and Wear Effects for Industrial Robots," in *2023 IEEE 19th International Conference on Automation Science and Engineering (CASE)*, Aug. 2023, pp. 1–8. DOI: 10.1109/CASE56687.2023.10260559.

F. Stöckl, M. Strand, S. Müller, M. Huber, J. Raible, C. Braun, D. Katic, B. Alt, and H. Merkt, "Autonomous Surface Grinding of Wind Turbine Blades," in *Intelligent Autonomous Systems 18*, S.-G. Lee, J. An, N. Y. Chong, M. Strand, and J. H. Kim, Eds., Cham: Springer Nature Switzerland, Jul. 2023, pp. 451–457, ISBN: 978-3-031-44981-9. DOI: 10.1007/978-3-031-44981-9_38.

2022   B. Alt, D. Katic, R. Jäkel, and M. Beetz, "Heuristic-Free Optimization of Force-Controlled Robot Search Strategies in Stochastic Environments," in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Oct. 2022, pp. 8887–8893. DOI: 10.1109/IROS47612.2022.9982093.

B. Alt, C. Kunz, D. Katic, R. Younis, R. Jäkel, B. P. Müller-Stich, M. Wagner, and F. Mathis-Ullrich, "LapSeg3D: Weakly Supervised Semantic Segmentation of Point Clouds Representing Laparoscopic Scenes," in *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Oct. 2022, pp. 5265–5270. DOI: 10.1109/IROS47612.2022.9981178.

2021   B. Alt, D. Katic, R. Jäkel, A. K. Bozcuoglu, and M. Beetz, "Robot Program Parameter Inference via Differentiable Shadow Program Inversion," in *2021 IEEE International Conference on Robotics and Automation (ICRA)*, May 2021, pp. 4672–4678. DOI: 10.1109/ICRA48506.2021.9561206.

S. Dittus, B. Alt, A. Hermann, D. Katic, R. Jäkel, and J. Fleischer, "Localization and Tracking of User-Defined Points on Deformable Objects for Robotic Manipulation," in *IEEE ICRA Workshop on Representing and Manipulating Deformable Objects*, Xi'an, China: IEEE, May 2021. arXiv: 2105.09067.

2020   B. Alt, F. Aumann, L. Gienger, F. Jordan, D. Katic, R. Jäkel, and B. Graf, "Modulare, datengetriebene Roboterprogrammierung für die Lösung komplexer Handhabungsaufgaben in Alltagsumgebungen," in *AAL-Kongress 2020*, Berlin: VDE Verlag, 2020, pp. 17–22, ISBN: 978-3-8007-5342-0.

Manuscripts in Submission

2024   B. Alt, C. Kienle, D. Katic, R. Jäkel, and M. Beetz, *Shadow Program Inversion with Differentiable Planning: A Framework for Unified Robot Program Parameter and Trajectory Optimization*, Sep. 2024. DOI: 10.48550/arXiv.2409.08678. arXiv: 2409.08678 [cs].

C. Kienle, B. Alt, D. Katic, and R. Jäkel, *QueryCAD: Grounded Question Answering for CAD Models*, Sep. 2024. DOI: 10.48550/arXiv.2409.08704. arXiv: 2409.08704 [cs].

Awards & Honors

2018-2019   Merit scholarship of the German Acad. Scholarship Foundation (Studienstiftung des deutschen Volkes)

2012-2019   e-fellows Merit Scholarship (Deutsche Telekom, Georg v. Holtzbrinck & McKinsey)

Grants

2024-2026   German Ministry of Education and Research grant #16KIS2236
Resilient, Intelligent Time-Sensitive Networks (RESI-TSN)
Co-PI

2024-2026   German Ministry of Education and Research grant #13GW0735C
Automated Workflow for the Patient-Specific Carbon-Reinforced Orthopedic Products (AutoKOOP)
Co-PI

2023-2026   German Ministry of Education and Research grant #03LB3097A
Continuous Fiber-Reinforced Low-Density Thermoplastic Additive Manuf. (ConfidentAM)
Co-PI (from 10/2024)

2023-2025   German Ministry of Economic Affairs and Climate Action grant #13IK017A
Networked Ditigal Assistant for the Data-Driven Engineering of Robot Workcells (VADER)
PI (from 10/2024), Collaborator

2023-2025   German Ministry of Economic Affairs and Climate Action grant #13IK026A
A Digital and Automated Value Chain for Wiring Harness Manufacturing (Next2OEM)
Co-PI (from 10/2024), Collaborator

2023-2025   German Ministry of Economic Affairs and Climate Action grant #01MD22002B
Efficient Analysis and Control in a Dyn. Edge-Cloud-Continuum for Industr. Production (EASY)
Co-PI (from 10/2024), Collaborator

2022-2025   German Ministry of Economic Affairs and Climate Action grant #01MJ22003B
GANs and Semantics for Resilient, Flexible Robotic Production (GANResilRob)
Co-PI (from 10/2024), Collaborator

2021-2025   German Ministry of Education and Research grant #02L19C255
Competency Center Artificial Intelligence for Working and Living in the Karlsruhe Region (KARL)
Co-PI (from 10/2024), Collaborator

2021-2024   German Ministry of Education and Research grant #13GW0471B
Cognitively Assisted Laparoscopy: A Learning Robotic Assistance System for Surgical Grasping and Holding Tasks (Koala-Grasp)
Collaborator

2021-2023   Baden-Württemberg Ministry for the Economy, Labor and Tourism, InvestBW grant #BW1_0079
Hybrid AI for Flexible Robotic Surface Treatment (RoboGrind)

Collaborator

2020-2023   German Ministry of Education and Research grant #16SV8406
A Multifunctional Service Robot to Support Care Professionals in the Hospital (HoLLiECares)
Collaborator

2021-2024   German Ministry of Education and Research grant #01IS20008C
AI-based Robot Calibration (KIRK)
Collaborator

2019-2022   German Ministry of Education and Research grant #01DR19001B
Imitation Learning from Human Demonstrations in Virtual Reality for Physical Human-Robot
Interaction in Assistance Tasks (ILIAS)
Collaborator

2017-2018   German Ministry of Economic Affairs and Energy, ZIM grant #ZF4337302LF7
Frameworks and Technologies for the Monitoring, Analysis and Online Adaption of Industrial
Robotic Production Processes (MonRob)
Collaborator

2017-2020   German Ministry of Education and Research grant #16SV7836
Robust Perception Skills for Robotic Household Assistance in the Context of Elderly Care (RoPHa)
Collaborator

2019-2022   German Ministry of Education and Research grant #02L17C556
Proactive Diagnosis and Conception of Collaborative Robot Deployment in Small and Medium-
Sized Enterprises (ProBot)
Collaborator

Invited Talks

2024   "GPUs sind das neue Öl: Die KI-Revolution im deutschen Mittelstand erfordert ein Umdenken
bei der Bereitstellung kritischer Rechenkapazitäten"
Tag der digitalen Technologien, Fachforum "Generative KI als Schlüssel zur Innovation!? Er-
fahrungen aus der (Arbeits-)Praxis"
German Ministry for Economic Affairs and Climate Action, Berlin, 8.10.2024

"Verständlich, Sicher, Beherrschbar: Hybride KI für industrielle Anwendungen" Innovative Ar-
beitswelten im Mittelstand
Projektträger Karlsruhe (PTKA) at Karlsruhe Institute of Technology (KIT), Karlsruhe, 20.09.2024

"Ein interaktiver KI-Assistent für die Refabrikation mit Robotern: Datensparsam und flexibel
dank hybrider KI"
KI-Showroom-Insight: KI und Produktion
FZI Research Center for Information Technology, Karlsruhe, 27.06.2024

"What's in Your Head? Neurosymbolic AI for Intelligent Robots that we Understand"
e-fellows IT Day
ZEIT Verlagsgruppe, McKinsey & Company Inc, Stuttgart, 26.04.2024

2023   "Intelligente Programmierassistenten für die industrielle Robotik"
Revolution der Robotik: Lösungen aus Baden-Württemberg
German Chamber of Commerce and Industry (IHK), Karlsruhe, 13.07.2023

Conference Activity

PAPERS PRESENTED

2024   "RoboGrind: Intuitive and Interactive Surface Treatment with Industrial Robots", IEEE International Conference on Robotics and Automation (ICRA), May 13-17

"Human-AI Interaction in Industrial Robotics: Design and Empirical Evaluation of a User Interface for Explainable AI-Based Robot Program Optimization", 57th CIRP Conference on Manufacturing Systems (CMS), May 29-31

"BANSAI: Towards Bridging the AI Adoption Gap in Industrial Robotics with Neurosymbolic Programming", 57th CIRP Conference on Manufacturing Systems (CMS), May 29-31

"Domain-Specific Fine-Tuning of Large Language Models for Interactive Robot Programming", European Robotics Forum (ERF), March 13-15

2023   "EfficientPPS: Part-aware Panoptic Segmentation of Transparent Objects for Robotic Manipulation", 56th International Symposium on Robotics (ISR Europe), September 26-27

"Knowledge-Driven Robot Program Synthesis from Human VR Demonstrations", 20th International Conference on Principles of Knowledge Representation and Reasoning (KR), September 2-8

2022   "LapSeg3D: Weakly Supervised Semantic Segmentation of Point Clouds Representing Laparoscopic Scenes", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), October 23-27

"Heuristic-Free Optimization of Force-Controlled Robot Search Strategies in Stochastic Environments", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), October 23-27

"Localization and Tracking of User-Defined Points on Deformable Objects for Robotic Manipulation", IEEE ICRA Workshop on Representing and Manipulating Deformable Objects, May 19

"Robot Program Parameter Inference via Differentiable Shadow Program Inversion", IEEE International Conference on Robotics and Automation (ICRA), May 30 - Jun 5

2020   "Modulare, datengetriebene Roboterprogrammierung für die Lösung komplexer Handhabungsaufgaben in Alltagsumgebungen", AAL-Kongress, September 29 - October 1

Departmental Talks

2024   "Neurosymbolic Robot Programming: Bridging the Gap between Safe and Capable Robot Intelligence"
2024 EASE Fall School
University of Bremen/University of Michigan, Bremen, 13.11.2024

2022   "Knowledge Representation and Reasoning in Industrial Robotics"
2022 EASE Fall School
University of Bremen, 23.09.2022

Research Experience

2020-2025   Model-based first-order robot program optimization with neural digital twins
Led research endeavor spanning 6 publicly funded research projects to develop the foundations of learned, modular, differentiable forward models of robot and environment dynamics, and their use in model-based robot program optimization.

2022-2025   Interactive, natural-language robot program synthesis
Led research endeavor spanning 4 publicly funded research projects to develop an AI assistant capable of synthesizing robot programs for complex, long-horizon tasks through natural-language dialogue with human users.