



Evaluation of Mathematics, ICT and Technology (EVALMIT) 2023-2024

Self-assessment for research group Robotics and Intelligent Systems (ROBIN)

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Research group (name and short name): Robotics and Intelligent Systems (ROBIN)

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Content

1. Organisation and strategy	3
1.1 Research group's organisation	3
1.2 Research group's strategy	5
1.3 Relevance to the institution	7
1.4 Research group's resources	7
1.5 Research group's infrastructures	8
1.6 Research group's cooperations	9
2. Research quality	10
2.1 Research group's scientific quality	10
2.2 Research group's societal contribution	21
3. Challenges and opportunities	25

About the department/administrative unit:

The UiO Department of Informatics (IFI) is a leading institution in Northern Europe for research and education in informatics and computer science. With a staff of more than 400, it is the largest such unit in Norway and the one with the strongest international rankings. Around a comprehensive core in computer science, IFI interprets informatics in substantial breadth: from microelectronics, robotics or signal processing to participatory design or digital innovation. In 2023, IFI hosts five BSc and eight MSc study programmes with close to 2500 students. The department is organised in four thematic sections, each of which comprises 2–5 research groups. Our group, Robotics and Intelligent Systems (ROBIN), is a part of the section for machine learning.

1. Organisation and strategy

1.1 Research group's organisation

Describe the establishment and the development of the research group, including its leadership, researcher roles, the group's role in researcher training, mobility and how research is organised.

The **Robotics and Intelligent Systems (ROBIN)** group is one of five research groups in the Section for Machine Learning at IFI. Our research focus is on systems like robots and smartphones operating in dynamic environments demanding adaptation at run-time. ROBIN has much experience in artificial intelligence (AI) and machine learning (ML), and from simulation and rapid prototyping of robots using 3D-printers and other machines. We work both at a fundamental level of research where evolutionary algorithms are important methods and in an applied domain where ML techniques are often applied. A common theme for much of the applied research is within health and care applications using smartphones and/or robots. A part of that is making the systems provide personalised functionality where a good trade-off between efficiency and safety is targeted. In addition to developing robot technology, we regard it as important to contribute to developing user-friendly technology; thus, we also consider ethical issues and perform user studies. In section 2.1, we outline how ROBIN contributes to new versions of state-of-the-art AI algorithms as well as demonstrate new application areas of existing algorithms. That is, through ROBIN's increased research quality and quantity in the last decade, we now regard ourselves as having an internationally important role within our field of research.

The establishment and the development – The ROBIN group was established in Sept. 2006 by two permanent staff members (associate professor and professor), one PhD fellow and one researcher, all from the Microelectronic Systems group. The motivation was to initiate research on robotics and AI techniques which was then a new branch of research at the department. In 2011, we had grown to become a group of three permanent staff members, two postdoc fellows, nine PhD fellows, one engineer and three adjunct positions (18 members). In 2022, ROBIN consisted of five permanent staff members, two researcher faculty, two postdoc fellows, ten PhD fellows (plus two with other funding), two engineers and six adjunct positions (27 members).

We have, since the beginning, had several labs equipped with state-of-the-art equipment (funded by UiO and RCN) for motion capture and prototyping of robot parts using 3D printers, Computer Numerical Control (CNC) milling machines, laser cutters and more. These facilities are important both in our research and education. We have one engineer (Søyseth) who takes care of procurement, installation, operation support, maintenance, etc., for ROBIN and another engineer (Bergflødt) who manages the department's makerspace (see more in section 2.2).

Group leadership – The group is led by a group manager (Tørresen) together with the permanent staff. We communicate through e-mails and shared documents, and we meet regularly for two-hour meetings. In this way, information is shared, and topics related to research and education are discussed. We communicate in a similar way with all employees of the group. In addition to using an e-mail list, we use [a group wiki page](#), an online chat channel, and we meet weekly for [a one-hour lunch seminar](#). The meeting contains both news sharing and research presentations by one or more ROBIN members. We also have several social meeting points like daily lunch and annual events like summer barbeque and Christmas Party, to which our master's students are also invited.

Researcher training and how research is organised – Training of researchers is through meetings with their respective supervisor teams. In addition, regular project meetings are held for one or multiple of the group's ongoing projects.

The group has seen gradual growth as a result of an increasing number of students and external research funding. The research is supported by a combination of internally funded PhDs/postdocs and externally funded research projects (RCN and EU, see Table 4). In the evaluation period, we have seen an increasing number of PhD fellows and postdoc fellows. We have employed 13 postdoc fellows in the period, and there have been, on average, two graduating PhD fellows per year (the majority with the main supervisor from ROBIN).

Most of the projects involve interdisciplinary collaboration. We think it is important in such projects to have equality in the distribution of resources available so each main partner can perform relevant research for their field rather than only support the research of other fields. One way of achieving that is by having the PhD fellows and postdoc fellows allocated across the key partners in a project. At the same time, we often have co-supervisors from other partners to support the integration of project activities and strengthen interdisciplinary collaboration.

Mobility – Around 2016, we started to actively extend our international collaboration. Thus, we applied for and were successful in receiving funding for several projects for international collaboration that started in 2017. We got a two-year project for collaboration with universities in Brazil (ROCAIR, funded by the UTFORSK scheme for 2017-2018) and a four-year networking project for collaboration with partners in Brazil, Japan and USA (COINMAC, funded by the RCN INTPART scheme, 2017-2021). The latter was continued through one more similar project for 2021-2024. An important objective of the projects has been to provide our students with international experience. Thus, we have had a number of outgoing (19) and incoming (7) master's and PhD fellows doing their research projects during their exchange (in collaboration with NASA Jet Propulsion Lab. (JPL) and Univ. of California, San Diego in the US, UFRGS univ. in Brazil, and in Japan: Kyushu Univ, Nagoya Univ, Toyohashi Univ and Tsukuba Univ). This has resulted in many co-authored papers (15) with international collaborators. Further, to provide all students, and especially those not doing exchange, experience with international research, we have had a number of international guest lectures. This has largely been a part of the master's/PhD course that we have established as a result of these projects – IN5490/9490 see section 1.2c.

ROBIN members by 1st October 2022 (21 full time members, organised by role):

- Professors: Kyrre Harald Glette and Jim Tørresen (group manager)
- Associate professors: Kai Olav Ellefsen and Mats Erling Høvin
- Lecturer: Yngve Hafting
- Postdoctoral fellows: Alexander Szorkovszky and Frank Veenstra
- Doctoral Research Fellows: Adel Baselizadeh, Julian Peter Fuhrer, Björn Thor Jonsson, Mojtaba Karbasi Seyed, Katrine Linnea Nergård, Farzan Majeed Noori, Emma Stensby Norstein, Marieke van Otterdijk, Benedikte Wallace and Shin Watanabe
- Researchers: Ulysse Teller Masao Côté-Allard and Diana Saplacan
- Engineers: Adrian Anderson Bergflødt and Vegard Dønnem Søyseth
- Adjunct Professors: Ole Jakob Elle, Weria Khaksar, Tønnes Frostad Nygaard, Ståle Andreas van Dorp Skogstad, Roar Skogstrøm, Alexander Wold

Table 1. List of number of personnel by categories

	Position by category	No. of researcher per category	Share of women per category (%)	No. of researchers who are part of multiple (other) research groups at the admin unit	No. of temporary positions
No. of Personnel	Position C (1013 Professor)	2	0	0	
	Position B (1011 Assoc. prof.)	2	0	0	

by position	Position A (1009 Lecturer)	1	0	0	
	Position G (1352 Postdoc fellow)	2	0	0	2
	Position D (1017 Doctoral Research Fellow)	10	40%	0	10
	Position E (1109 Researcher)	2	50%	0	
	Engineer (1181 Senior Eng. and 1085 Princ. Eng.)	2	0	0	
	Adjunct Professor (1009, 1011, 1013, 1109, 1198)	6	0	0	6

1.2 Research group's strategy

a) **The research group's main goals, objectives and strategies to obtain these** (e.g. funding, plans for recruitment, internationalisation etc. within the period 2012-2022.)

The group's strategy is to perform high-impact basic research in computational intelligence and robotics while developing systems to meet societal challenges, particularly in health. The strategy builds on the department strategies combined with the last evaluation of the group (2011), which are outlined below.

The **department's strategy for 2014–2017** emphasises, “All research groups are expected to participate in relevant national and international competitions for research projects.” And more specifically, mention “Medicine and health” as an area “the department wants to further develop”. Another topic is to target for better gender balance. The **department's Action Plan 2019–2021** follows up these with a number of central values that include “seek quality in all activities; have a clear responsibility for meeting societal challenges; have an active policy for equality and a recruitment policy that provides diversity.” Further, “Machine Learning and Artificial Intelligence” is listed as one of the *Priority Subject Areas*. Regarding research, among the key points is “work for more international mobility and contact”. We think the ROBIN group has been successful in meeting these goals – as outlined in this self-evaluation, e.g., in sections 1.1 and 1.6.

Main comments to ROBIN from the last evaluation (2011) – contribute to the research excellence:

Focus the research in a few key areas: We decided not to continue the research on reconfigurable digital hardware but rather to make machine learning in combination with robotics more included in our research proposals and projects. This also corresponded well with the evaluation report's overall comment about the *lack of focus on machine learning within the department as a whole*.

Increase collaboration with other research groups inside and outside of the department: We have, during the evaluation period, collaborated with several research groups inside and outside the department through research projects; see sections 1.1 above and 1.6 below.

Very strong need to publish more in journals: We think we have addressed this well; see section 2.1.

b) **The benchmark of the research group**

Without being too broad, our group's main objective is to contribute to, on the one hand, fundamental research on automatic design and adaptation of robot body and control, and on the other hand, to improve and add new functionality to robot assistants where user testing is an important part of the research. The groups' benchmark is, to a large extent, given by department strategies and the recommendations from the previous evaluation (2011). These are outlined above in the previous section 1.2a.

Benchmark 1: Increase collaboration/succeed with a Centre of Excellence application – We had an ambition before the current evaluation period to be a part of an interdisciplinary Centre of Excellence. Thus, we submitted the RCN Centre of Excellence proposal “*Centre for Mind and Motion in Music and Machines (fourMs)*” proposal in 2011. It was not funded, but we continued with the new proposal, “*Centre for Interdisciplinary Studies in Rhythm, Time and Motion (RITMO)*”, in 2016. This was successful and is in operation (2018–2027).

Benchmark 2: Publish in high-quality venues, including more journals – One of the important recommendations was to increase the proportion of papers published in journals compared to conferences. We have had a large increase in our attention to publishing in journals in the last years (see statistics in section 2.1), but we also find continued attention to publishing in high-quality conferences to be important because there are a number of conferences that are among the best publication venues in our field. Part of the reason is that work presented at conferences gets published more quickly and may get immediate attention and citations from the research community. This is regarded especially important in the field of AI with rapid research progress and since the research community is large. Quality is ensured by full papers being reviewed and only a limited fraction of the submitted papers being accepted. Further, the collaboration should be visible through some of the papers being co-authored with national and international colleagues.

Benchmark 3: Improve the gender balance in the group – The gender balance in 2011 was not good, with no female ROBIN members. We have managed to change this drastically with a number of current female ROBIN members, see Table 1. We regard this as a result of the integration of research in teaching, resulting in increased recruitment of PhD fellows among graduated students from our master’s program. Many of our female employees are also actively engaged in teaching and outreach, which we believe is important for the future recruitment of female students and staff.

c) The research group contribution to education (master's degree and/or PhD)

Manage a study program: The ROBIN group manages the *Robotics and Intelligent Systems* bachelor and master’s study program. It is one of the department’s five programs offered at both bachelor’s and master’s levels and admits annually 73 students at the bachelor’s level. The program focuses on robotics and embedded systems. That is, how to make such systems more intelligent and adaptable using programming, machine learning, artificial intelligence and other methods based on informatics. This program covers the competence needed in today’s large robot and embedded systems industry in Norway ([see one article about the industry here](#)). The master’s program with ROBIN specialisation now enrolls about 25 new students each year, and we have seen an increasing number of graduated students that have doubled in the last ten years (18 on average 2018-22, among the highest at IFI and 25 in 2023). The drop-out rate has been relatively low, and we think our close follow-up through master project selection and implementation has contributed positively.

Courses taught and integration of research in teaching: The group is responsible for two bachelor-level courses, three courses available both at bachelor’s and master’s levels and two master’s courses that are also available as PhD courses. Several different options for integrating research into teaching for an intensive course have been assessed and led to a master’s/PhD-level course being established in 2018 (*IN5490/IN9490 – Advanced Topics in Artificial Intelligence for Intelligent Systems*, also mentioned in section 1.1). It is given annually in an intensive course format, covering state-of-the-art research topics in AI, and also includes learning about writing a scientific paper. Students are clustered into groups of three, and each group does their own small research project. We also include international collaborators (funded by the COINMAC project) to contribute with scientific guest lectures (24 in total, 2018-2022), project proposals and supervision of research projects, which are important parts of the course. Further, every year, the works of several of the best groups are published in international conferences. Another positive effect of establishing the course is that we see that it has contributed to increased interest among our own master’s students in applying for our vacant PhD positions. This, in turn, has led to

substantial improvements in ROBIN's gender balance. We have, since the course started, hired eight new PhD fellows, out of which four are female (three former own master's students), while we had none before 2018. We think the IN5490/IN9490 course is much to thank for that positive development.

PhDs and postdocs: As mentioned above in section 1.1, we have also seen an increasing number of PhD fellows and postdocs in the evaluation period, with, on average, two graduating PhD fellows per year (the majority with the main supervisor from ROBIN). Further, we have had 13 postdocs in the period. Among these, one of the PhD fellows and four of the postdoc fellows have advanced to faculty positions (Associate Professor) at Norwegian universities.

d) The support the host institution provides to the research group

The administrative support related to research consists of budget planning and accounting staff, PhD administration and research advisors. Related to education, we have support for student recruitment, admission, administration, examination and more.

The group manages a number of lab rooms that are equipped with rapid-prototyping equipment, acquired commercial robots and motion capture systems. Among the equipment that is available are state-of-the-art motion capture facilities, robots, 3D-printers and CNC milling machines. Further, we have misc. local and central high-performance computing resources at UiO, see more in section 1.5b).

1.3 Relevance to the institution

Describe the role of the research group within the organisation. Consider the group's contribution towards the institutional strategies and objectives and relate the group's benchmark to these.

ROBIN has machine learning and AI as main components in our research and education; thus, we contribute as one of five groups in the Machine Learning section to the department's strategy of strengthening this area. Further, the group is one of several research groups in our department that work with physical systems in lab environments. Thanks to access to prototyping facilities and lab environments, we have experienced the large potential for developing innovative robot systems. That results in more unique research than if working only in simulation – which can be important in getting papers accepted in high-impact publication venues. Working with physical systems can also be very appealing to the media, and we contribute to publicity that benefits the department and our institution.

At the same time, our research is interdisciplinary with institution-internal, national and international collaboration, see sections 1.2a and 1.6. Moreover, our contribution to reaching our benchmarks also contributes to increasing the overall gender balance and research quality of the department and the institution, see section 1.2b. Thus, in several ways, we commit to important goals in the strategies within our organisation.

1.4 Research group's resources

Describe the funding portfolio of the research group the last five years (2018-2022).

The ROBIN group has for the last five years been successful in attracting substantial external funding as outlined in the list of projects in Table 4 (between mNOK 7 and mNOK 11.5 annually 2018–2022, in total mNOK 47.2). About half of the listed projects are with ROBIN as the project coordinator/manager (EPEC, MECS, PIRC, COROBOREES and COINMAC). The majority of the funding is for undertaking research through hiring PhD fellows and postdocs. However, we have also been successful in receiving several projects for international collaboration within research and teaching (more than mNOK 7.3 has been acquired since 2017, mainly from RCN). The projects have allowed both ROBIN members and students to make short and long visits abroad, respectively. Many of the researchers funded by RCN projects

have also applied for and received additional funding from RCN for doing 3-6 months of exchanges abroad. Further, we have organised several international conferences (e.g. [ICDL 2019](#)) where external funding has been important to offer moderate registration fees.

Table 2. Describe the sources of R&D funding for the research group in the period 2018-2022.

	2018 (kNOK)	2019 (kNOK)	2020 (kNOK)	2021 (kNOK)	2022 (kNOK)
Basic funding	3028	4775	5622	5103	6615
Funding from industry and other private sector sources					
Commissioned research for public sector					
Research Council of Norway	9420	9829	6977	9121	10518
Grant funding from other national sources					
Int. funding e.g. NIH, NSF, EU framework programmes				322	965

1.5 Research group's infrastructures

Research infrastructures are facilities that provide resources and services for the research communities to conduct research and foster innovation in their fields.

a) National infrastructures the research group manages or co-manages

The institution provides access to high-performance computing resources which are widely used across Norway. Similarly, the *Services for sensitive data (TSD)* hosted by UiO can collect, store and analyse sensitive research data in a secure environment. Although our group doesn't manage these infrastructures, our access to them makes us attractive as collaborators in research proposals (e.g. it was applied in the INTROMAT project). When working with person-identifiable data, we have the *Norwegian Agency for Shared Services in Education and Research (Sikt)*, which provides support in, e.g., making data management plans and providing recommendations for data collection and data handling in studies with human participants. We have, in recent years, obtained much competence in undertaking experiments with humans. That includes collecting participant consent and procedures for collecting, storing and processing multi-modal data. ROBIN has also been active in making collected datasets publicly available like:

- Depresjon: A Motor Activity Database of Depression Episodes in Unipolar and Bipolar Patients [Proc. of 9th ACM multimedia systems conf. \(2018\)](#)
- DeepDance: Motion capture data of improvised dance, [zenodo.org \(2019\)](#)

b) The most important research infrastructures used by the group

Much of our research involves a need for high-performance computing resources (FOX, Sigma 2, USIT ML nodes and more) to undertake studies where machine learning and artificial intelligence algorithms are applied. In addition to centralised computing resources at our institution and department, respectively, our group has local computing resources that are important for program development and pilot testing (providing both GPU and CPU processing). Further, as mentioned in section 1.2d, the group disposes of a number of lab rooms that are equipped with rapid-prototyping equipment, acquired commercial robots and motion capture systems (additional equipment is available in RITMO, see section 1.6).



Among the equipment that is available are state-of-the-art motion capture facilities (Optitrack), robots (a Universal Robots UR5 robot arm and a TIAGo assistive robot), 3D-printers (FUNMAT PRO 310 and Markforged Mark X) and a DATRON neo CNC milling machine. Among the more recent acquisitions is the TIAGo assistive robot (shown on the left) for which we obtained funding and acquired in 2021. It contains a gripper on a manipulator arm mounted on a mobile base. It contains an open architecture based on the open-source framework Robot Operating System (ROS). It has become a frequently used resource for master's students, PhD fellows and postdoc fellows for both technical development and Human-Robot Interaction studies.

1.6 Research group's cooperations

Table 3. *Reflect on the current interactions of the research group with other disciplines, non-academic stakeholders and the potential importance of these for the research.*

The ROBIN group has, in the evaluation period, been involved in a number of interdisciplinary and transdisciplinary projects in a range of different sectors. We decided to respond here with text paragraphs rather than filling in Table 3 since we found it hard for our research and network to distinguish between the three categories in the table.

Collaboration within the department: One of the successful projects where we collaborated with research groups inside the department was the 16 MNOK RCN-funded Multimodal Elderly Care Systems (MECS, 2016-2021) project. The project was coordinated by the ROBIN group in close collaboration with the DESIGN group at the department. We had a supervisor team across the two groups, with several in-kind PhD fellows contributing to strengthening the project. In summary, the project resulted in 18 journal papers and 38 peer-reviewed conference papers (56 publications in total). Further, we have had more than 100 other dissemination activities, e.g., media articles, invited talks and tutorials.

Collaboration with other disciplines outside the department: The main research initiative outside the department, but inside the university, has been the establishment of the RCN-funded RITMO Centre of Excellence (SFF). It performs interdisciplinary studies in rhythm, time and motion through the study of human and robot rhythm mechanisms in perception, cognition and acting. RITMO gathers a strong and highly interdisciplinary team of colleagues across the university represented by the three different departments (from different faculties): informatics, musicology and psychology. Informatics is represented by members from the ROBIN group. ROBIN's lab facilities are applied by RITMO researchers and likewise, ROBIN staff and students get access to RITMO's extensive lab facilities including motion capture, eye tracking/pupillometry and Electroencephalography (EEG) brain signal recording.

The group also has an active collaboration with Simula's BioAI-centre on bio-inspired AI and with, among others, the Norwegian Geotechnical Institute (NGI) on underwater robotics for gas leakage detection. There are also other initiatives like the 25 MNOK RCN project Vulnerability in the Robot Society (VIROS, 2019–2025), where the budget split between the ROBIN group and the Norwegian Research Center for Computers and Law (NRCCL) centre at the UiO Department of Private Law). The goal of the project is to co-develop technology and proposals for regulatory measures to reduce vulnerabilities regarding robotics. The focus is on privacy, security and safety, particularly in healthcare contexts. As for the past MECS project, we are also in the VIROS project, undertaking robot studies with older people through a collaboration with the Diakonveien Omsorg+ unit. This is a housing facility with care apartments close to the university campus. They represent one of the **non-academic stakeholders** with whom we perform **transdisciplinary research**.

International collaboration: The group has, in the evaluation period, also had extensive international collaboration. Many of the PhD fellows have undertaken 3-6 months of exchange abroad with leading research groups (e.g. CSIRO in Australia, Univ. of Michigan-Dearborn in the US, and Kyoto Univ. and Tohoku Univ. in Japan). This has been funded by various sources like RCN for candidates in positions funded by RCN. We have also, since 2017, had two separate RCN INTPART projects for establishing and strengthening international collaboration; see more details in section 1.1 (ROCAIR and COINMAC). Our collaborations have led to a large number of published papers co-authored with international partners.

2. Research quality

2.1 Research group's scientific quality

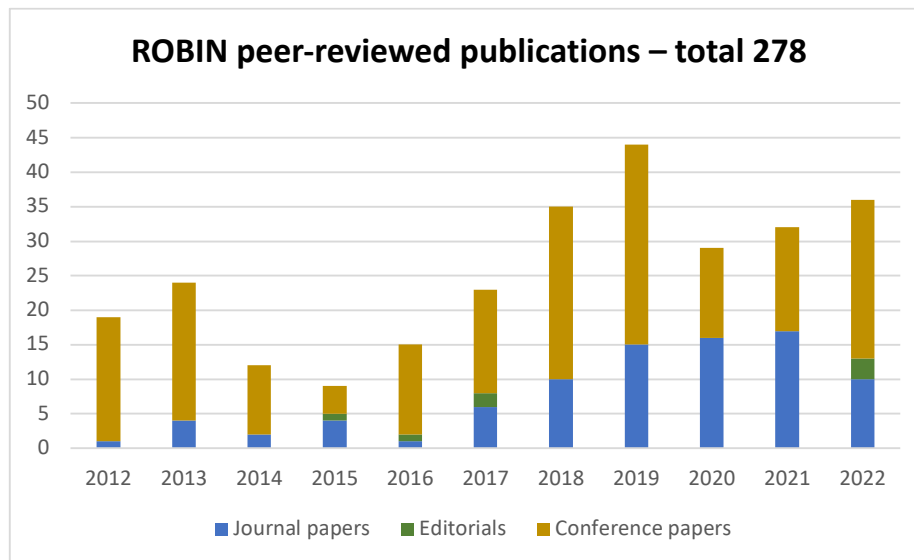
Describe the research profile of the group and the activities that contribute to the research group's scientific quality. Consider how the group's work contributes to the wider research within the group's field nationally and internationally.

Thematically, ROBIN has since 2011 continued its focus on research in the intersection of robotics and artificial intelligence – benefiting from collaborations with excellent research groups nationally and internationally. ROBIN researchers are progressing in algorithms by proposing new versions of state-of-the-art algorithms through our studies within improving efficiency and generalisation of AI algorithms, cognitive psychology-inspired computing and combining feature extraction and classification algorithms in new ways. Further, we also apply existing algorithms for new types of data/sensors and applications.

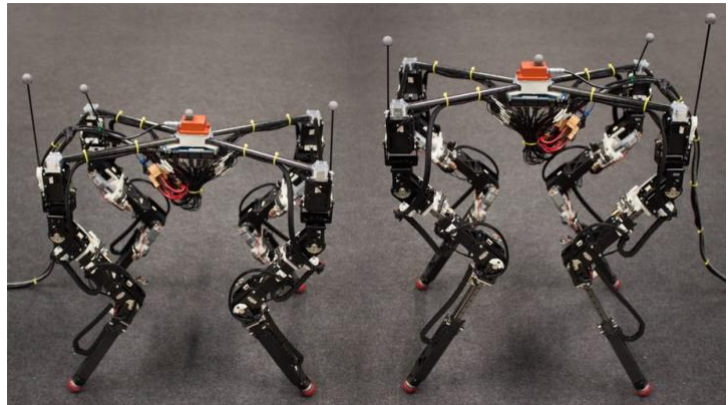
The increasing impact of AI and robotics on our society and daily lives has also made it important to address these technologies' societal and ethical implications in our research. This is reflected in an increasing focus on topics like privacy, safety, human-robot interaction and ethics in AI, as can be seen in our list of projects and publications. Covering several areas in the intersection of AI, robotics and applications of these technologies, ROBIN has made extensive contributions to the wider research within the group's field. We think ROBIN is one of few groups in Norway as well as internationally that have the interdisciplinary competence needed to integrate AI, ML and robotics regarding both technical as well as non-technical research challenges. Thus, we regard ourselves among the world leaders in the field of robotics and intelligent systems and our projects (see Table 4), the interdisciplinary RITMO centre and our published papers are a documentation of that; e.g., we have one published paper in Nature Machine Intelligence from 2021 and several others in the best relevant journals and conferences.

As seen in the figure below, the scientific production of ROBIN has increased significantly in recent years – and we are especially pleased to have had a large increase in the publication in high-quality publication venues. We have several papers each year in level 2 journals, with a total of 20 during 2018-2022 (four annually on average). The total number of papers in the whole period is 278, where we have more than doubled the number from the first to the second half of the period. At the same time, the proportion of journal articles has increased from 18% to 40%. Regarding collaboration, 35% of our published papers have international co-authors, and 21% have national co-authors (during the whole period).

An important contribution to the research group's scientific quality is our participation in the RCN-funded RITMO Centre of Excellence (SFF), introduced in sections 1.2b and 1.6. Staff from ROBIN represents one of the three pillars in the centre – by our focus on machine learning, AI and robotics. Novel research appears in the interaction with the two other pillars represented by musicology and psychology.



As a specific example of our impactful research in the intersection of AI and robotics, our group has been among the first to introduce a robot that is mechanically adaptable in the real world. That is, a robot where not only the control but also the body adapts through a real-world training process. Our in-house rapid prototyping facilities have been essential for this work. The four-legged robot has the capability to adjust its leg lengths to compromise between speed and stability. A number of high-impact papers have resulted from this work; see the papers by former ROBIN PhD fellow Nygaard in Table 5.



Another example of our contribution to the international research arena is our frequent contributions to the main international conferences in our fields. In 2019, ROBIN members organised the **IEEE International Conference on Development and Learning (ICDL)**, 170 attendees) in Oslo, which is one of the main conferences facilitating the exchange of ideas between AI and psychology research communities. Many members of ROBIN have also been active in various ways in contributing to other conferences in recent years, including organising tutorials and workshops (20 in 2018-2022). This includes conferences that are among the best in our research fields, such as ALIFE, ICRA, IROS, SCCI and WCCI/IJCNN. We have further been giving a large number of invited talks at conferences and other institutions (56 in 2018-2022) and serving as Associate Editors and reviewers for international journals and conferences.

The quality of ROBIN's research has, in recent years, also been acknowledged in the form of several prestigious awards being granted to members of our group. These include two awards from NORA – The Norwegian Artificial Intelligence Research Consortium: Jim Tørresen received the 2023 Lifetime Achievement Award, and Kai Olav Ellefsen and co-authors received the NORA Award for Outstanding Publication of the Decade 2012 – 2022. Vegard Søyseth, the group's lab responsible engineer, received the 2021 University of Oslo Environment, Health and Safety Award.

A link to the research group's publication list at the research group's website:
<https://www.mn.uio.no/ifi/english/research/groups/robin/publications/>

Table 4. List of projects

Instructions: Please select 5-10 projects you consider to be representative/the best of the work in the period 1 January 2012 – 31 December 2022. The list may include projects lead by other institutions nationally or internationally.

Project 1: RITMO Centre of Excellence for Interdisciplinary Studies in Rhythm, Time and Motion <i>Project period: 2018-2027</i>	Project owner(s) (project leaders organisation)	University of Oslo (ROBIN/IFI contributes with PIs)
	Total budget and share allocated to research group	Total budget from RCN is NOK 140,700,000. NOK 59,000,00 is allocated to the centre administration + NOK 21,803,000 is allocated to the ROBIN group. In addition, the institution provides RITMO an additional in-kind of 55% of the total budget (NOK 303 million).
	Objectives and outcomes (planned or actual) and link to website	The centre performs interdisciplinary studies in rhythm, time and motion through the study of human and robot rhythm mechanisms in perception, cognition and acting. RITMO gathers a strong and highly interdisciplinary team of colleagues across the university represented by the three different departments within informatics, musicology and psychology affiliated with their respective faculty. Informatics is represented by members from the ROBIN group. Website: https://www.uio.no/ritmo/english
Project 2: Predictive and Intuitive Robot Companion (PIRC) <i>Project period: 2020 – 2026</i>	Project owner(s) (project leaders organisation)	University of Oslo (ROBIN/IFI is leading the project, but it is also integrated with RITMO)
	Total budget and share allocated to research group	Total budget from RCN with the whole amount allocated to ROBIN: NOK 16,000,000
	Objectives and outcomes (planned or actual) and link to website	PIRC targets a psychology-inspired computing breakthrough through research combining insight from cognitive psychology with computational intelligence to build models that forecast future events and respond dynamically. The systems will be aware and alert for how to act best given their knowledge about themselves and their perception of their environment. The models will be applied in two robotics applications with the potential for very wide societal impact: physical rehabilitation and home care robot support for older people. The project is both affiliated with ROBIN and RITMO. Website: https://www.uio.no/ritmo/english/projects/pirc/index.html

Project 3: Vulnerability in the Robot Society (VIROS) <i>Project period: 2019 – 2025</i>	Project owner(s) (project leaders organisation)	University of Oslo (Department of Private Law and ROBIN/IFI leading the project)
	Total budget and share allocated to research group	Total budget from RCN is NOK 24,997,000, out of which with NOK 12,956,000 is allocated to ROBIN.
	Objectives and outcomes (planned or actual) and link to website	The project is a collaboration between the ROBIN group and the <u>Norwegian Research Center for Computers and Law (NRCCL)</u> centre at the UiO Department of Private Law. The goal of the project is to co-develop technology and proposals for regulatory measures to reduce vulnerabilities regarding robotics. The focus is on privacy, security and safety, particularly in healthcare contexts. Website: https://www.ius.uio.no/ifp/english/research/projects/nrccl/viros/
Project 4: Multimodal Elderly Care Systems (MECS) <i>Project period: 2016 – 2021</i>	Project owner(s) (project leaders organisation)	University of Oslo (ROBIN/IFI was leading the project)
	Total budget and share allocated to research group	Total budget from RCN was NOK 12,000,000, out of which NOK 8,869,000 was allocated to ROBIN. The remaining amount was allocated to a PhD fellow affiliated with the DESIGN group (with co-supervision from the ROBIN group).
	Objectives and outcomes (planned or actual) and link to website	The objective of the project was to create and evaluate multimodal sensing systems for mobile human-supportive robots that are able to sense, learn and predict future events . That is, the goal was to develop sensing technology so a robot could act as a personal safety alarm for older people living by themselves at home. Further, such technology can easily be seen as a threat to privacy and lack of interpersonal contact. Thus, the project also addressed these issues by user-centred design. The project was coordinated by the ROBIN group in close collaboration with the DESIGN group at the department. Website: https://www.mn.uio.no/ifi/english/research/projects/mecs/
Project 5:	Project owner(s) (project leaders organisation)	University of Oslo (ROBIN/IFI was leading the project, but it was also integrated with RITMO)
	Total budget and share allocated to research group	Total budget from RCN with the whole amount allocated to ROBIN: NOK 9,000,000

Engineering Predictability with Embodied Cognition (EPEC) <i>Project period: 2015 – 2019</i>	Objectives and outcomes (planned or actual) and link to website	The objective and novelty of the project have been the design of behavioural models as well as the combination of these with predictive systems to accurately model behaviour and predict future actions and events. The models are relevant to be applied in embedded systems and were tested in the interdisciplinary fields of music and robotics. 44 peer-reviewed scientific papers resulting from the project. In addition, there have been 16 popular science publications/events and 15 articles in public media. The project was both affiliated with the ROBIN group and RITMO. Website: https://www.uio.no/ritmo/english/projects/completed-projects/epec/index.html
Project 6: INTroducing personalized TReatment Of Mental health problems using Adaptive Technology (INTROMAT) <i>Project period: 2016 – 2021</i>	Project owner(s) (project leaders organisation)	Haukeland University Hospital, Bergen (ROBIN/IFI was a work package leader)
	Total budget and share allocated to research group	Total budget from RCN was NOK 48,000,000, out of which NOK 6,487,000 was allocated to ROBIN.
	Objectives and outcomes (planned or actual) and link to website	INTROMAT project's goal has been to improve mental healthcare by introducing new technologies for adaptive interventions in mental healthcare through interdisciplinary research and development. UiO/ROBIN was one of several partners representing clinical as well as technical domains. At UiO, we focused on training personalised mental health intervention systems using machine learning. Website: https://www.mn.uio.no/ifi/english/research/projects/intromat/index.html
Project 7: Engineering Proprioception in Computing Systems (EPiCS) <i>Project period: 2010 – 2014</i>	Project owner(s) (project leaders organisation)	University of Paderborn, Germany (ROBIN/IFI was a work package leader)
	Total budget and share allocated to research group	Total budget from the European Commission FP7 was NOK 39,960,000, out of which NOK 5,464,000 was allocated to the ROBIN. UiO/ROBIN was one of eight partners.
	Objectives and outcomes (planned or actual) and link to website	The EPiCS project aimed to lay the foundation for engineering a novel class of proprioceptive computing systems. Proprioceptive computing systems collect and maintain information about their state and progress, which enables self-awareness by reasoning about their behaviour, and self-expression by effectively and autonomously adapting their behaviour to changing conditions. UiO/ROBIN had a focus on developing nature-inspired algorithms for proprioceptive systems and demonstrating how they could be applied in an interactive music system. The EC project reviews the last three years concluded with "Excellent progress". Website: https://www.mn.uio.no/ifi/english/research/projects/epics/index.html

Project 8: Collaboration on Intelligent Machines (COINMAC) <i>Project period: 2017–2021</i>	Project owner(s) (project leaders organisation)	University of Oslo (ROBIN/IFI was leading the project)
	Total budget and share allocated to research group	Total budget from RCN with the whole amount allocated to ROBIN: NOK 3,500,000
	Objectives and outcomes (planned or actual) and link to website	This project has been concerned with international collaboration between ROBIN and leading partners in the US, Brazil and Japan within the domains of self-learning systems and robots. It has provided an extended momentum to several of our RCN-funded research projects by collaborating in research and teaching, and strengthening the interaction between the two domains. This has been achieved through a set of different activities like short-term and long-term reciprocal mobility stays by staff and students for collaboration in research, curriculum and teaching material development, and organising intensive courses/workshops. This has resulted in 15 scientific papers co-authored with international partners being published at peer-reviewed international conferences and in journals. We have also been guest editors of a number of journal special issues; see Table 6. Website: https://www.mn.uio.no/ifi/english/research/projects/coinmac/
Project 9: Collective ROBOTics through Real-time Entrainment of Evolved dynamical Systems (COROBOREES) <i>Project period: 2021 – 2023</i>	Project owner(s) (project leaders organisation)	University of Oslo (ROBIN/IFI was leading the project, but it was also integrated with RITMO)
	Total budget and share allocated to research group	Funding from the European Commission under <i>Excellent Science – Marie Skłodowska-Curie Actions</i> . The total budget was NOK 1,931,000 with the whole amount allocated to the ROBIN.
	Objectives and outcomes (planned or actual) and link to website	The COROBOREES project provided a bottom-up approach to social behaviour in automated systems. Combining methods from evolutionary robotics, collective behaviour, and sound and music computing, it incorporated social information into the motion controllers of virtual agents. The project built on the central pattern generator that is used in robotic controllers for cyclic motions such as walking. A simulation platform with sensorimotor mechanisms was also developed. Website: https://www.uio.no/ritmo/english/projects/synchronized-robotics/index.html

Project 10: European Digital Virtual Design Lab (eDiViDe) <i>Project period: 2011–2014</i>	Project owner(s) (project leaders organisation)	Katholieke Hogeschool Limburg, Belgium (ROBIN/IFI one of four project partners)
	Total budget and share allocated to research group	Funding from the European Commission under the <i>Erasmus programme</i> within the Lifelong Learning Programme (LLP). The total budget was NOK 2,400,000, and the share allocated to ROBIN was NOK 817,000.
	Objectives and outcomes (planned or actual) and link to website	Four European universities collaborated in developing web-accessible digital design labs. The goal was for students to learn digital design for FPGA (reconfigurable logic) from anywhere through Internet. Each partner developed their own physical setup. Website: https://www.mn.uio.no/ifi/english/research/projects/edivide/index.html

Table 5. Research group's contribution to publications

Instructions: Please select 5-15 publications from the last 5 years (2018-2022) with emphasis on recent publications where group members have a significant role.

Publication 1: <i>Mental health monitoring with multimodal sensing and machine learning: A survey</i> Pervasive and Mobile Computing 2018 https://doi.org/10.1016/j.pmcj.2018.09.003 (4.3 Impact Factor, 263 citations) The paper received in 2023 the <u>Best Survey Paper 2018-2020 Award</u> from the journal.	Authors (Please highlight group members)	Enrique Garcia-Ceja , Michael Riegler, Tine Nordgreen, Petter Jakobsen, Ketil J Oedegaard, Jim Tørresen
	Short description	Personal and ubiquitous sensing technologies such as smartphones allow the continuous collection of data in an unobtrusive manner. Machine learning methods have been applied to continuous sensor data to predict user contextual information such as location, mood, physical activity, etc. This paper surveys recent research works in mental health monitoring systems using sensor data and machine learning.
	Research group's contribution	The majority of the work has been undertaken by the first author (Garcia-Ceja), who was a member of ROBIN at the time of preparing the paper.

Publication 2: <i>A Review of Future and Ethical Perspectives of Robotics and AI</i> Frontiers in Robotics and AI 2018 https://doi.org/10.3389/frobt.2017.00075 (3.4 Impact Factor, 185 citations)	Authors (Please highlight group members)	Jim Tørresen
	Short description	In recent years, there has been increased attention on the possible impact of future robotics and AI systems. This article reviews work considering both the future potential of robotics and AI systems and ethical considerations. References to recent initiatives to outline ethical guidelines for both the design of systems and how they should operate are included.
	Research group's contribution	The author is a member of ROBIN
Publication 3: <i>Two-stage transfer learning for heterogeneous robot detection and 3D joint position estimation in a 2D camera image using CNN</i> Proceedings of the 2019 International Conference on Robotics and Automation (ICRA) 2019 http://doi.org/10.1109/ICRA.2019.8794077 (12 citations)	Authors (Please highlight group members)	Justinas Miseikis, Inka Brijack, Saeed Yahyanejad, Kyrre Glette, Ole Jakob Elle, Jim Tørresen
	Short description	Collision avoidance is important for robots. The paper introduces a stand-alone system capable of detecting the robot and estimating its position, including individual joints, by using a simple 2D colour image as an input where no Eye-to-Hand calibration is needed. Our method is capable of detecting the robot in real-time and new robot types can be added by having significantly smaller training datasets compared to the requirements of a fully trained network.
	Research group's contribution	Most of the work has been undertaken by the first author (PhD fellow Miseikis), who was a member of ROBIN. The work was undertaken in collaboration with a research lab Miseikis had an exchange with.
Publication 4: <i>Deep Learning for Electromyographic Hand Gesture Signal Classification Using Transfer Learning</i> IEEE Transactions on Neural Systems and Rehabilitation Engineering 2019 https://doi.org/10.1109/TNSRE.2019.2896269	Authors (Please highlight group members)	Ulysse Côté-Allard, Cheikh Latyr Fall, Alexandre Drouin, Alexandre Campeau-Lecours, Clément Gosselin, Kyrre Glette, François Laviolette and Benoit Gosselin
	Short description	This paper presents a novel method for learning to recognise gestures from persons based on electromyography data from armbands they were wearing. The method applies transfer learning on aggregated data from multiple users while leveraging the capacity of deep learning algorithms to learn discriminant features from large datasets.

(4.9 Impact factor, 624 citations) This paper won the 1st Prize in the 2022 IEEE Engineering in Medicine and Biology Prize Paper Award.	Research group's contribution	The first author (Côté-Allard, the main contributor to the data collection, experiments and paper preparation) was a visiting researcher at the ROBIN group for one year while working on this paper. He was co-supervised by one member of the ROBIN research group (Glette), who also contributed to the paper. The collaboration with Côté-Allard continued, and he later became a member of the ROBIN group (2021-2023).
Publication 5: <i>Human activity recognition from multiple sensors data using multi-fusion representations and CNNs</i> ACM Transactions on Multimedia Computing, Communications, and Applications 2020 https://doi.org/10.1145/3377882 (5.1 Impact factor, 38 citations)	Authors (Please highlight group members)	Farzan M Noori, Michael Riegler, M. Zia Uddin, Jim Tørresen
	Short description	With the emerging advancements in the ubiquitous sensing field, it has become possible to build assistive technologies for persons during their daily life activities to provide personalised feedback and services. In this paper, we explore several methods of fusion for multi-representations of data from sensors combined with Deep Convolutional Neural Networks (CNNs).
	Research group's contribution	All authors from our research group
Publication 6: <i>Guiding neuroevolution with structural objectives</i> Evolutionary Computation 2020 https://doi.org/10.1162/evco_a_00250 (4.77 Impact factor, 11 citations)	Authors (Please highlight group members)	Kai Olav Ellefsen, Joost Huizinga, Jim Tørresen
	Short description	The structure and performance of neural networks are closely connected, and by the use of evolutionary algorithms, structures optimally adapted to a given task can be explored. This paper introduces ways to optimise neural networks more efficiently using additional objectives related to networks' structure in a multi-objective evolutionary algorithm.
	Research group's contribution	ROBIN member Kai Olav Ellefsen performed the experiments in this paper – some of them based in part on code written by Joost Huizinga. Kai Olav Ellefsen wrote most of the paper, with edits and reviews from Joost Huizinga and Jim Tørresen.

Publication 7: <i>Real-world embodied AI through a morphologically adaptive quadruped robot</i> Nature Machine Intelligence 2021 https://doi.org/10.1038/s42256-021-00320-3 (5-year Impact Factor: 27.2, 52 citations)	Authors (Please highlight group members)	Tønnes Nygaard, Charles P. Martin, Jim Tørresen, Kyrre Glette and David Howard
	Short description	Here we present the first quadrupedal robot that can morphologically adapt to different environmental conditions in outdoor, unstructured environments. Our solution is rooted in embodied AI and comprises two components: (1) a robot that permits in situ morphological adaptation and (2) an adaptation algorithm that transitions between the most energy-efficient morphologies on the basis of the currently sensed terrain.
	Research group's contribution	The majority of the work has been undertaken by the ROBIN PhD fellow Nygaard, who was a visiting researcher for six months in Australia (hosted by Howard). The other co-authors are with the research group. Glette and Howard share senior authorship.
Publication 8: <i>Learning embodied sound-motion mappings: Evaluating AI-generated dance improvisation</i> 13th ACM Conference on Creativity & Cognition 2021 https://doi.org/10.1145/3450741.3465245 (8 citations)	Authors (Please highlight group members)	Benedikte Wallace, Charles P Martin, Jim Tørresen and Kristian Nymoen
	Short description	In this paper, we explore the creative capacity of a generative model trained on 3D motion capture recordings of improvised dance. We perform a perceptual judgment experiment wherein respondents rate movement generated by our model as well as human performances. When compared to examples of human dance, our study shows that in certain aspects related to perceived dance-likeness and expressivity, the model successfully mimics human dance movement.
	Research group's contribution	All authors from our research group
Publication 9: <i>Environmental Adaptation of Robot Morphology and Control Through Real-World Evolution</i> Evolutionary Computation 2021	Authors (Please highlight group members)	Tønnes Nygaard, Charles P. Martin, David Howard, Jim Tørresen and Kyrre Glette
	Short description	Robots operating in the real world will experience a range of different environments and tasks. In this article, we rely solely on real-world evaluations and apply evolutionary search to yield combinations of morphology and control for our mechanically self-reconfiguring

https://doi.org/10.1162/evco_a_00291 (4.77 Impact factor, 22 citations)		quadruped robot. We find that the evolutionary search finds high-performing and diverse morphology-controller configurations by adapting both control and body to the different properties of the physical environments.
	Research group's contribution	The majority of the work has been undertaken by the first author (Nygaard). Collaboration with Howard (CSIRO, Australia). The other co-authors are with the research group.
Publication 10: <i>Motion Planning and Obstacle Avoidance for Robot Manipulators Using Model Predictive Control-based Reinforcement Learning</i> 2022 IEEE International Conference on Systems, Man, and Cybernetics (SMC) https://doi.org/10.1109/SMC53654.2022.9945504	Authors (Please highlight group members)	Adel Baselizadeh, Weria Khaksar and Jim Tørresen
	Short description	This paper presents a Nonlinear Model Predictive Control-based Reinforcement Learning (NMPC-based RL) framework for robot manipulators. The controller is developed to address the motion planning problem for robot manipulators in the presence of obstacles.
	Research group's contribution	All authors from our research group

Table 6. A list with the research groups monographs/scientific books.

1	What is Artificial Intelligence (2013, pop. sci. book in Norwegian, Scandinavian University Press, Norwegian equivalent to e.g. Oxford University Press' "Very Short Introductions"). Jim Tørresen https://www.universitetsforlaget.no/hva-er-kunstig-intelligens-2
2	Special Issue on <i>Self-Aware and Self-Expressive Systems</i> in "IEEE Computer Magazine" (2015). Jim Tørresen , Christian Plessl and Xin Yao. https://ieeexplore.ieee.org/document/7163237
3	Self-aware Computing Systems (2016, Springer book). Peter R. Lewis, Marco Platzner, Bernhard Rinner, Jim Tørresen , Xin Yao. https://link.springer.com/book/10.1007/978-3-319-39675-0
4	Proceedings of the 9th Joint IEEE International Conference on Development and Learning and on <i>Epigenetic Robotics</i> (2019). Editors: Kai Olav Ellefsen and Katharina J. Rohlfing. https://ieeexplore.ieee.org/xpl/conhome/8843356/proceeding
5	Special Issue on Elderly Care Robotics – Technology and Ethics in « <i>Journal of Intelligent & Robotic Systems</i> » Jim Tørresen , Ryo Kurazume & Edson Prestes (2020). https://link.springer.com/article/10.1007/s10846-020-01148-6
6	IEEE Transactions on Cognitive and Developmental Systems: Special Issue on Development and Learning and on Epigenetic Robotics in " <i>IEEE Transactions on Cognitive and Developmental Systems</i> " (2022). Kai Olav Ellefsen , Kerstin Dautenhahn and Jim Tørresen . https://ieeexplore.ieee.org/document/9976489
7	Frontiers in Robotics and AI: Research topic (special issue) on <i>Evolving Robotic Morphologies</i> (2022). David Howard, Kyrre Glette , Nick Cheney

2.2 Research group's societal contribution

Describe the societal impact of the group's research. Consider contribution to education, economic, societal and cultural development in Norway and internationally.

ROBIN's scientific focus is an area of great importance to Norway's industrial development and to the society as a whole: As robots and AI become a more and more integrated part of our daily lives, it is important that we all have a certain understanding of the possibilities, limitations, and ethical challenges of these technologies. We are, therefore, actively involved in the education and dissemination of both technical and non-technical topics related to robotics and AI.

Education: On the education side, we are involved in teaching many important courses in robotics, AI and related topics. As a notable example, ROBIN staff established a course on Biologically Inspired Artificial Intelligence in 2010. Along with growing interest in AI, the student population in the course grew rapidly, from tens of students to over 100 students in the final semesters. After 2018, the interest in a general introduction course to AI was so large that the course was redesigned, forming the basis for the course *IN3050/4050 - Introduction to Artificial Intelligence and Machine Learning*, which members of the research group are still central in teaching (in collaboration with the LTG group). This course has continued growing and is IFI's largest course on AI/machine learning. Together, these two courses have given thousands of students at the University of Oslo a foundation in artificial intelligence and machine learning.

Makerspace: The group also contributes to the recruitment of future students and supports the motivation for creativity and innovation of the current students through our responsibility for the department's makerspace, Sonen. It provides a facility for students to have practical assignments in courses and students' own hobby projects. It is also commonly used for regularly welcoming school children to solve assignments through collaboration (see picture to the right).



National organisations: ROBIN member Tørresen is a member of the Norwegian Academy of Technological Sciences (NTVA) and the National Committee for Research Ethics in Science and Technology (NENT), where he has been a member of a working group on research ethics for AI. The latter work has resulted in the report "Statement on research ethics in artificial intelligence" (2019). With reference to our own research, we are concerned with contributing to the understanding of and moderation of the public discussion about AI benefits and challenges.

Popular science dissemination: Several members of our research group have, in recent years, been active in disseminating knowledge about robotics and AI, both in presentations to public administration and the general public (e.g. through two TEDx talks and 19 popular science talks since 2018) and in articles in national and international media (more than 69 since 2018). We regard spreading this knowledge outside the university walls as increasingly important as these technologies are becoming more integrated into our society and daily lives – and we have also been experiencing an increasing interest in this type of dissemination in recent years.

Performances and Exhibitions: ROBIN, in collaboration with RITMO, has contributed to a number of external events both indoors (e.g. Museum of science and technology in Oslo) and outdoors (various festivals). These include typically musical performances integrating human performance supported by co-performing AI agents or custom drum robots.

Table 7. The research group's societal contribution, including user-oriented publications, products (including patents, software or process innovations)
Instructions: Please select 5–10 of your most important user-oriented publications or other products from the last 5–10 years with emphasis on recent publications/products. For each item, please use the following formatting: Please delete lines which are not used.

No.	Name of publication/product	Date of publication/product	Link to the document
1	Artificial Intelligence – A Human Technology? TEDx talk by Jim Tørresen	03.05.2017	https://www.youtube.com/watch?v=CanAgv21Ic&ab_channel=TEDxTalks
2	Ensemble Metatone at Elvelangs – Live performance by ROBIN-members with AI-instruments developed by ROBIN-postdoc Charles Martin	21.09.2017	https://www.uio.no/ritmo/english/projects/completed-projects/epec/news/2017-09-21-touchscreen-music-at-elvelangs.html
3	MicroJam – a mobile app for sharing tiny touch-screen performances. It includes several novel performance concepts intended to engage the casual music maker. Developed and released in Apple iTunes Store 2018 by Charles Martin	01.01.2018	Demo: https://www.youtube.com/watch?v=SkUjjQd13KU A paper explaining the app and analysing its usage: <i>Data Driven Analysis of Tiny Touchscreen Performance with MicroJam</i> . Computer Music Journal 2019; Volume 43 (4) http://hdl.handle.net/10852/81033
4	A minister together with the UiO Rector visit the ROBIN lab and are presented for one of our custom-built robots. Tønnes Nygaard and Kyrre Glette. National TV2	01.10.2018	https://www.mn.uio.no/ifi/forskning/grupper/robin/aktuelle-saker/robin-on-tv2-in-2018.mp4 (in Norwegian)
5	"Here is the University of Oslo's most self-learning robot." Yngve Vogt, Teknisk Ukeblad/Technical Magazine (a leading Norwegian engineering magazine). Covers research led by ROBIN PhD Fellow Tønnes Nygaard	06.12.2019	https://www.tu.no/artikler/her-er-universitetet-i-oslo-mest-selvlaerende-robot/480553 (in Norwegian)
6	"Statement on research ethics and artificial intelligence." National Committee for Research Ethics in Science and Technology (Jim Tørresen is a member of the committee)	01.11.2019	https://www.forskningsetikk.no/ressurser/publikasjoner/opinion-on-research-ethics-and-artificial-intelligence
7	Watch a Shape-Shifting Robot Prowl the Big, Bad World. Matt Simon, Wired . Covers research led by ROBIN PhD Fellow Tønnes Nygaard	15.03.2021	https://www.wired.com/story/watch-a-shape-shifting-robot-prowl-the-big-bad-world

8	"He teaches robots how the world works." Jon Kåre Time, Morgenbladet (Norway's oldest daily newspaper). Covers research led by ROBIN-Associate Professor Kai Olav Ellefsen	02.03.2020	https://www.mn.uio.no/ifi/english/people/aca/kaiolae/media/han-lerer-roboter-hvordan-verden-fungerer.pdf (in Norwegian)
9	What Happens when Art meets AI? TEDx talk by Benedikte Wallace	05.11.2021	https://www.ted.com/talks/benedikte_wallace_what_happens_when_art_meets_ai
10	"Meet the new health care worker" – The main article in an issue of the Norwegian magazine " Elektronikk " addressing the whole electronics and embedded systems industry in Norway. A large number of ROBIN members are interviewed.	24.11.2023	https://elektronikk.prenly.com/p/elektronikk/2023-11/r/1/1/5683/1123083 (in Norwegian)

3. Challenges and opportunities

We regard ROBIN to be a well-organised and productive research group demonstrating both increased research quality and research quantity during the evaluation period. This is to a large extent through externally funded projects and high-impact/highly cited papers which are partly a result of our national and international collaboration. Our research contribution is to the fields of fundamental and application-focused robotics research. At the same time, the robotics and intelligent systems study program led by ROBIN educates an increasing number of candidates much sought by Norwegian Industry, both in established companies and start-up companies. We have also demonstrated increased recruitment for our own PhD fellow positions which also has resulted in improved gender balance. We will strive to continue this in a sector with increasing demand for candidates with our competence.

In the coming years, we will continue to build on our strong areas at ROBIN and work to ensure a good after-life of the RITMO-SFF (ending in 2027), where we ensure that ROBIN retains the relevant expertise when funding from RCN to RITMO ends. This particularly applies to competence in "creative computing", machine learning applied to movement data and rhythmic robotics (robots as instruments and rhythmicity in robot movements). In recent years, ROBIN has published several articles in highly recognised journals. We have the ambition to continue with that, and our experience from the past will then be important. Further, we need to focus on continuing to apply for and being successful in attracting external funding.

We already have good interdisciplinary collaborations, which we want to maintain as they provide unique opportunities in research. This applies, among other things, to the collaboration with the Department of Psychology and the Department of Musicology at RITMO, the collaboration with the Department of Life Sciences and the Department of Physics at UiO's BioAI Center, and the collaboration with the Norwegian Research Center for Computers and Law (SERI) at the Faculty of Law in the field of regulation of AI and robots.

We see that much of our best and most talked about research in recent years has come in the cross-section between physical robots and artificial intelligence, and it is important for us to build on this area in the coming years. At the same time, the competence of our candidates is much needed both in industry and academia. Thus, we experience that it sometimes takes time to recruit good candidates. Further, we need to plan with some candidates (e.g. postdocs and researchers) leaving their positions before their contracts end. To mitigate the risk, we need to both make our group as attractive as possible as a workplace, while the department should also make the plans for future recruitment of permanent faculty as foreseeable as possible. That will be important since one of the main reasons members leave before their contracts end is offers for permanent positions elsewhere, while the probability of a permanent position in ROBIN is regarded as limited.