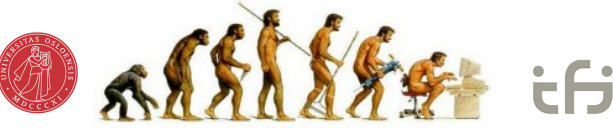



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Bio-inspired Computing for Robots and Music

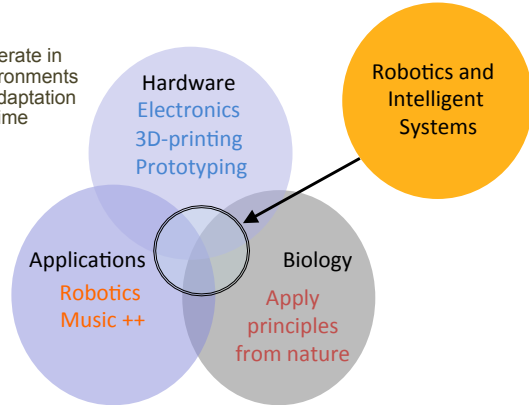
Jim Tørresen
Research group Robotics and Intelligent Systems

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Robotics and Intelligent Systems group

Systems operate in dynamic environments demanding adaptation at run-time


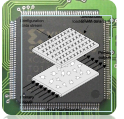



Web page: Google for "ROBIN IFI"

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Research


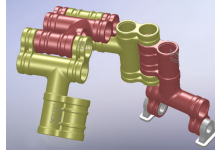
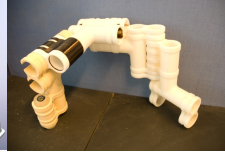
- Bio-inspired systems and machine learning
 - Evolutionary computation
 - Ant colony optimization
- Robotics
 - Custom built robots (3D-printing/milling)
 - Self-learning of control
 - Robot surgery
- Reconfigurable logic (FPGA)
 - Dynamic change of configuration
 - Self-learning and adaptive systems
 - Development of remote teaching labs
- Music technology
 - Analyze motion for flexible music control
 - Develop active music systems

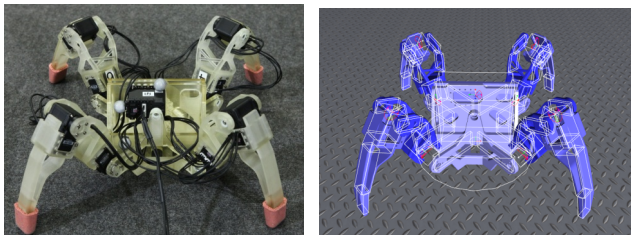
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State-of-the-art Rapid Prototyping Facilities

- 3D printers and milling machines
- Large potential for developing innovative robot systems.

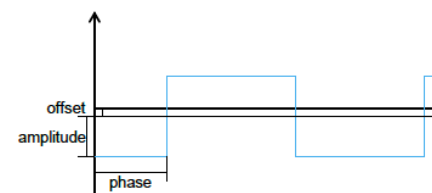
Robot Simulation in NVIDIA PhysX



- Work with real robot and simulator/models
- Co-evolve robot shape and walking pattern
- Study and try to reduce gap between reality and simulation

Evolved Control Systems

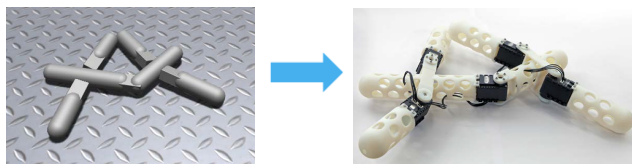
- We can evolve movement patterns!
 - Parameterize periodic functions for each joint
 - Evolve all those parameters



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Evolved Robot Design

- Robot bodies could be difficult to design by hand.
- We use evolutionary algorithm to evolve both body and control system simultaneously.




[Video Reuters](#)



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Bio-inspired Computing for Music




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State-of-the-art Motion Capture Facilities

- Allows precise tracking of human and robot motion
- Camera-based and on-body motion capture



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13 November 2016

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Sound Saber




13 November 2016

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Sound Saber



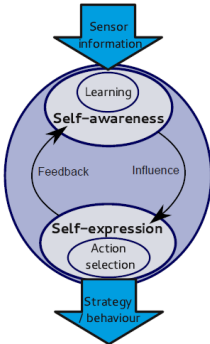
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EPiCS – Self-aware systems (EU proj.)



EPiCS
Engineering Proprioception
in Computing Systems

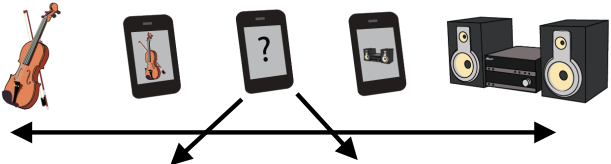


- Human/nature-inspired algorithms for self-awareness and self-expression
- Application: active music
- Collab: 8 European partners

November 13, 2016 14

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(Inter) Active Music



Direct Control

- Navigate within the song
- Control certain instruments (e.g. keep playing the chorus drumbeat in the verse)
- Change the tempo of the song

Indirect Control


- Use on-body sensors to adapt the music to the mood of the user
- Listen to music that pushes you to work out harder
- Fuse the musical preferences of multiple users into one song

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Ant Colony Optimization (ACO)

- Ants find shortest path to food source from nest.
- Ants deposit pheromone along traveled path which is used by other ants to follow the trail.
- This kind of indirect communication via the local environment is called stigmergy.



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Funky Sole Music

		current state			
		1-FullRelease	2-ToePress	3-HeelPress	4-FullPress
previous state	1-FullRelease	2	0	1	0
	2-ToePress	1	2	0	0
	3-HeelPress	0	0	1	1
	4-FullPress	0	1	1	1

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Funky Sole Music

Active music control by a sensor sole

- Combination of sound samples and synthesis
- Hierarchy of loops, controlled by the user
- Various sound effects are controllable when in different "states" (i.e., for different walking patterns)

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Video Reuters

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PheroMusic: Navigating a Musical Space

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Direct + Indirect Control Combined

EPICS
Engineering Proprioception
in Computing Systems

PheroMusic app

- Control by ant colony optimization

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INTROMAT: INtroducing personalized TRreatment Of Mental health problems using Adaptive Technology (2016-2022)

POCKET PSYCHIATRY



MOBILE MENTAL-HEALTH

Goal: Increase access to **mental health** services for common mental health problems by developing **smartphone technology** which can **guide patients**.

Funding: IKTPLUSS Lighthouse, Research Council of Norway




The Research Council of Norway

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MECS: Multi-sensor Elderly Care Systems
1 PhD (Trenton Schulz) + 2 postdocs (2015-2019)


Goal: Create and evaluate multimodal mobile **human supportive systems** that are able to **sense, learn and predict future events**.



Project consortium:

- Robotics and Intelligent Systems group (coordinator)
- DESIGN group (IFI)
- National:
 - Oslo Municipality (Oslo kommune, Gamle Oslo)
 - Norwegian Centre for Integrated Care and Telemedicine (Tromsø)
 - XCENTER AS (3D sensor)
 - Novelda AS (ultra wideband sensor)
- International:
 - University of Hertfordshire
 - University of Reading Whiteknights
 - Giraff Technologies AB

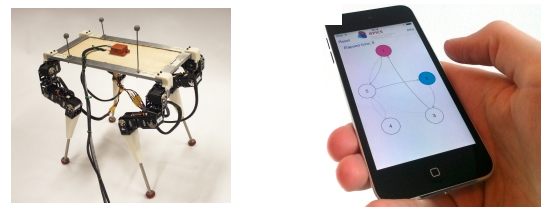
Funding: IKTPLUSS, Research Council of Norway (10% of proposals funded)



The Research Council of Norway


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EPEC: Prediction and Coordination for Robots and Interactive Music
1 PhD (Tønnes Nygaard) + 2 post-docs (Charles Martin and Kai Olav Ellefsen) 2015-2019



Goal: Design, implement and evaluate **multi-sensor systems** that are able to **sense, learn and predict future actions and events**.

Funding: FRIPRO, Research Council of Norway



The Research Council of Norway