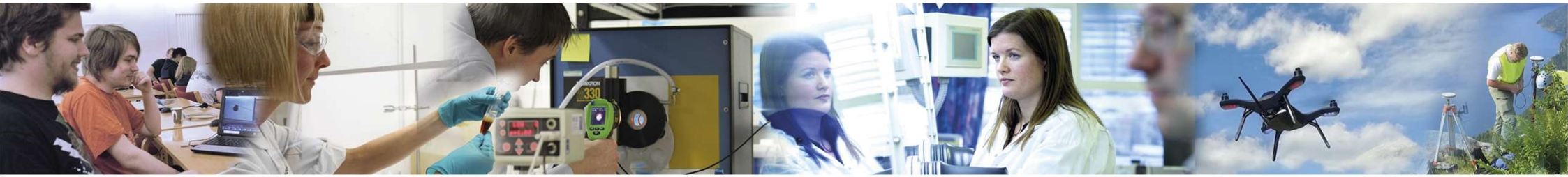


UiO : Department of Technology Systems
University of Oslo

Presentation of available Master theses at ITS

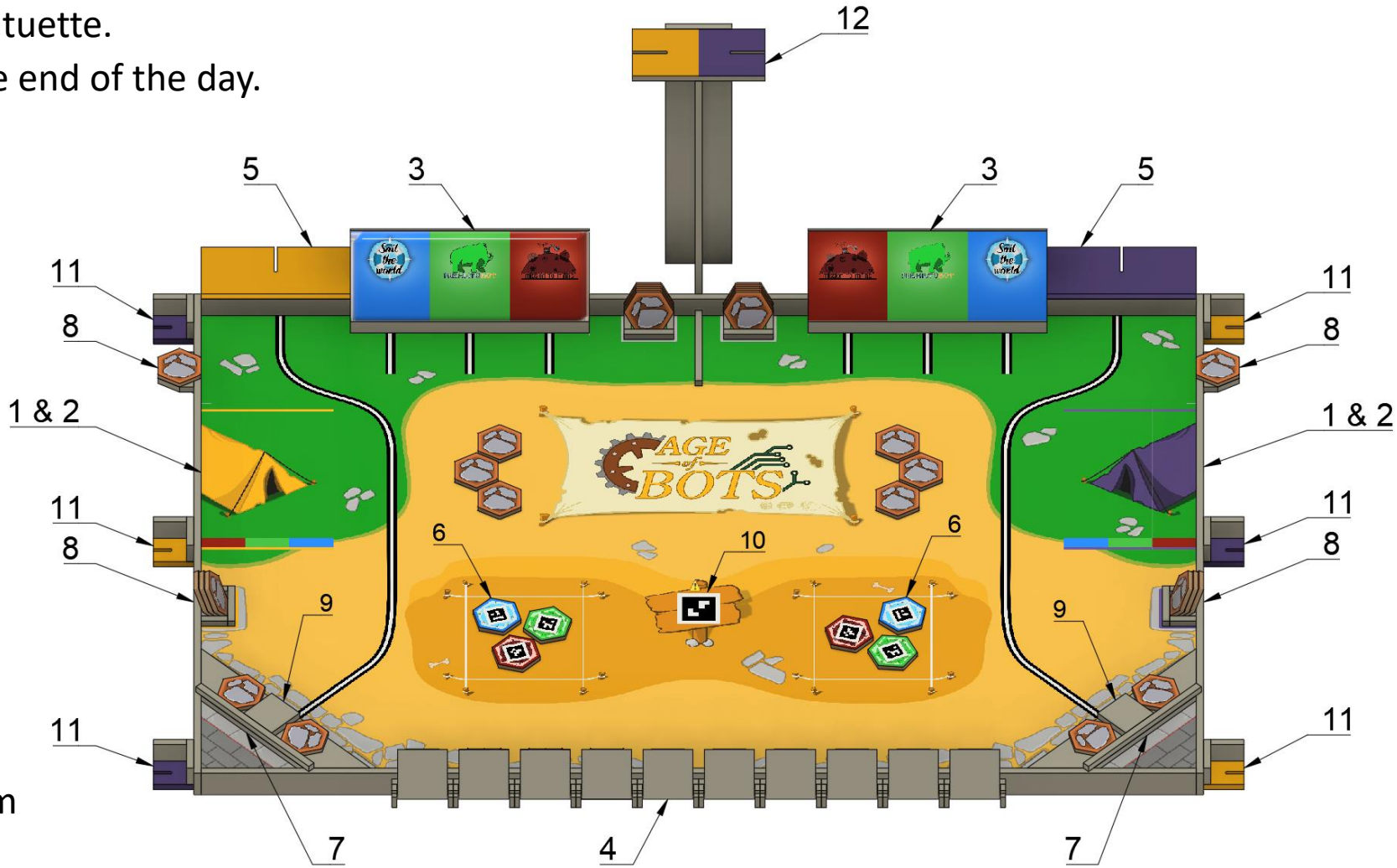
Orientation meeting 26 October

Eurobot 2022

After many years of exploring the world and the universe, our friends - the robots - have decided to explore their past. In 2022, the robots will go to search the ruins of an ancient robotic civilization for the forgotten fragments of their origin.

Design and build cool robots
Code, measure and test
Solve missions
Compete against teams from other universities

- Our missions will be:
  - Discovering the excavation square.
  - Researching and analysing samples.
  - Storing samples in the work shed.
  - Proudly displaying your discoveries in the museum.
  - Preserving and exhibiting the statuette.
  - Returning to the campsite, at the end of the day.
  - Estimating your performance.



The playing area is 300cm x 200cm with borders of 7cm height.


IMPRIMANTE 3D FRANCE


Solex
AIGRIS


Save the world
SICK
EXOTEC


ORYON
selva
EXOTEC
muRata
MICHELIN
SICK

eurobot

- Design og bygging av karosseri (CNC, laser, 3D print)
- Motor system og motor kontroller
- Gir system og gir backlash
- Hjultyper, odometri og driv system
- PID kontroller
- Sanntids- optimalisering
- Sensorer (lidar, IR, spenning …)
- Kamera system og maskinsyn
- Kunstig Intelligens
- Strategi og planlegging

- Deadline for registration: 31. desember 2021
- European final: summer 2022
- If a country has more than 3 teams there has to be a national final
- The upper age limit is 30 years for team members
- Each team is allowed to register a maximum of two robots
- Both robots are autonomous
- Each team is required to provide a technical poster of their robot

- Possible supervisors:
  - Kyrre Glette (ROBIN)
  - Kai (ROBIN), has participated in EuroBot as student at NTNU
  - Kim Mathiassen (ITS/FFI)

- Funding:
  - ITS will provide funding of 30.000,-
    - Robot components, playing area for test, travel to European Final in France
    - You decide how to spend the budget
    - You are expected to post some updates on social media
  - To compete amongst the top teams you will need to find additional sponsors

- The MotionCapture system is available for test and measurements

- https://www.eurobot.org/
- https://www.eurobot.org/eurobot-contest/eurobot-2022/
- https://www.coupederobotique.fr/
- https://www.coupederobotique.fr/edition-2021/le-concours/galerie-photo-de-la-coupe-et-trophees/

- Master ved UIO (Eurobot 2015):
- https://docs.google.com/presentation/d/18hKzUICXrgaqoZbfEcnFtsuBjFOG5QBTFMsK03FfAmc/edit#slide=id.p

UNIVERSITY
OF OSLO

Modelling spatially just allocation of renewable electricity generation

Oskar Vågerö

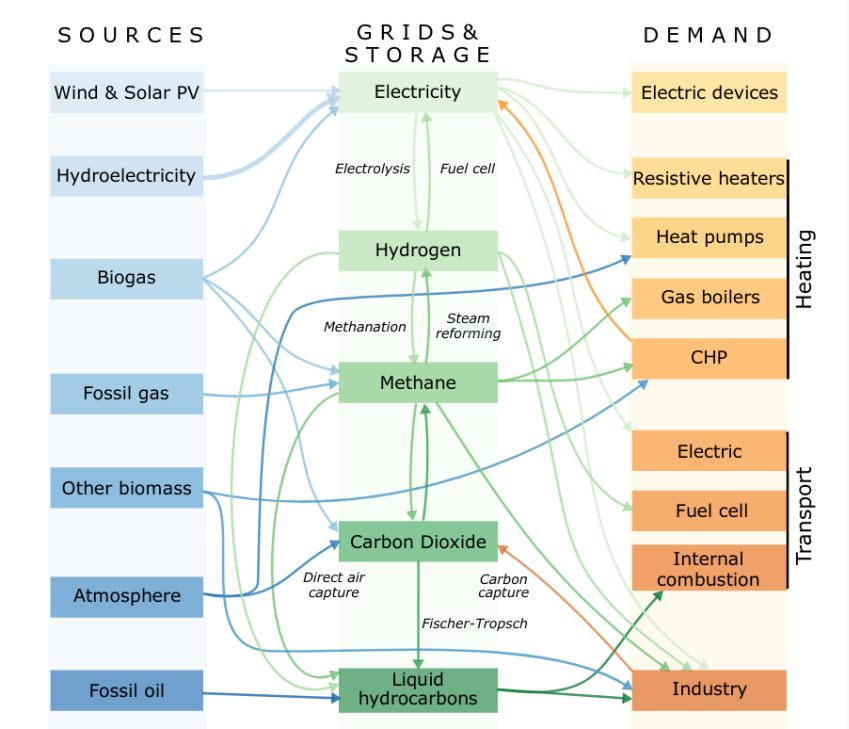
October 26, 2021

Department of Technology Systems

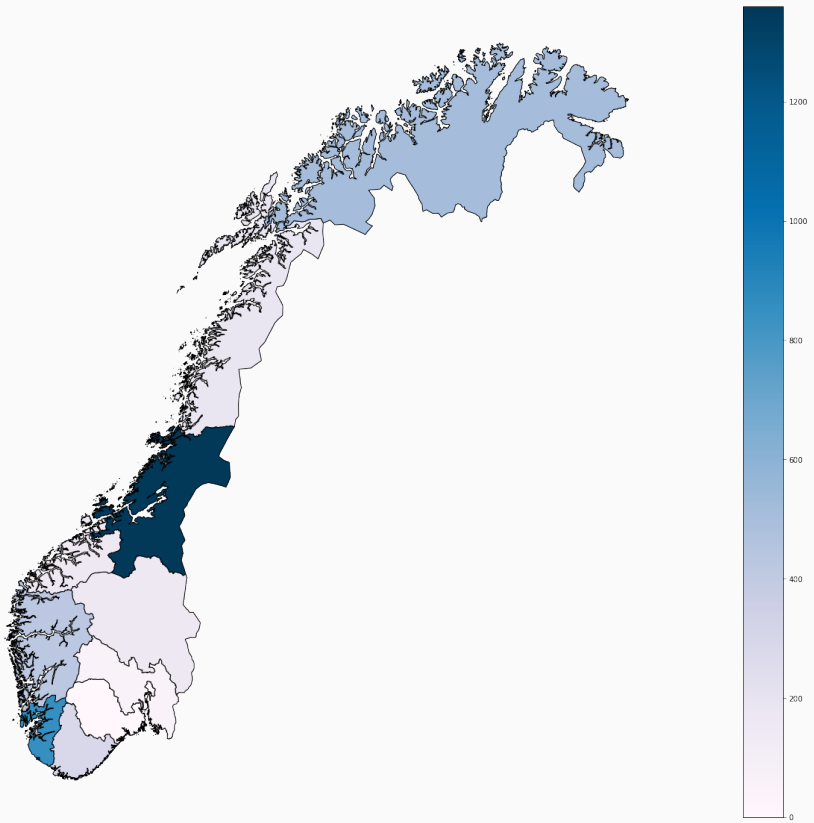
Modelling future power systems

Energy systems modelling utilises computer-models for energy systems analysis and how we can transition to low-carbon energy systems.

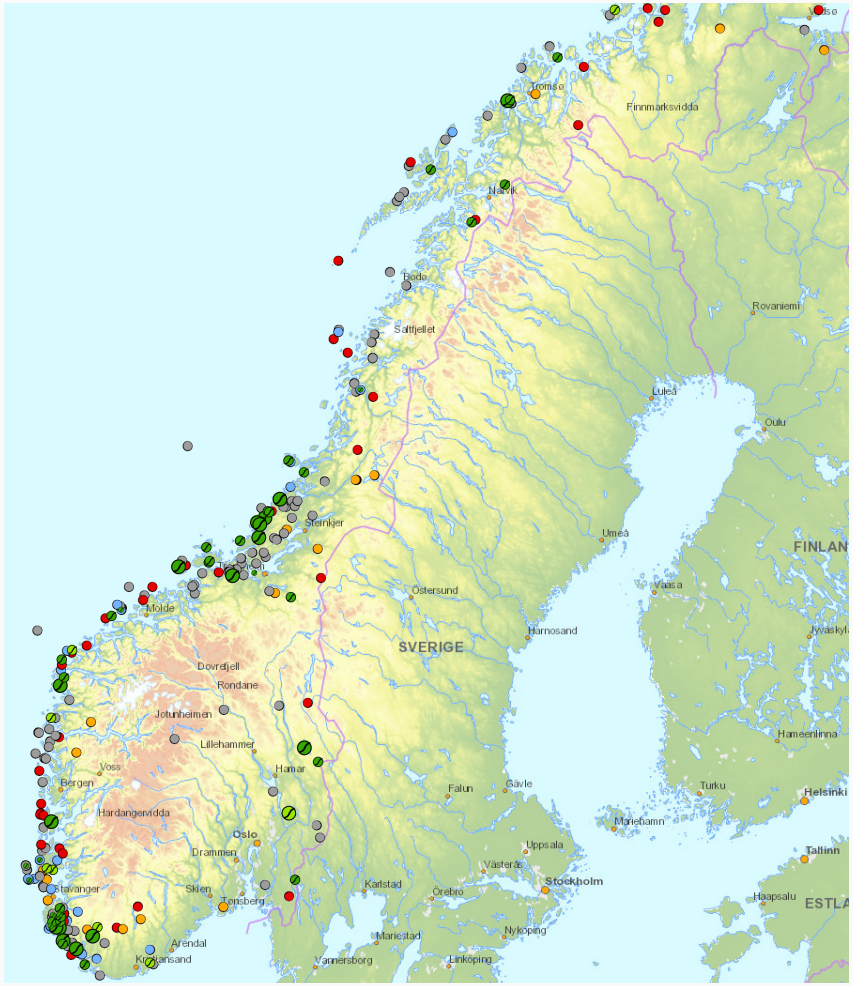
- Mathematical representation of national or regional energy systems
- Informs decision-making and navigating an uncertain future
- Social acceptance and fairness/justice/equity



How should we distribute renewable energy technologies?



Installed wind power by county



https://temakart.nve.no/tema/vindkraftverk

Objective

To work on an energy system model of either Norway or all of Europe and do modelling analysis of how using different equity principles impact the distribution of energy-related benefits and burdens.

Possible questions that the thesis could explore:

- What equity principles may be used for analysing distributive effects of different energy system designs?
- How will the regional and total distribution of different energy technologies vary between the different scenarios?
- What similarities exist between the different scenarios?

The thesis has a suggested framework but may be adjusted to fit the student's interests.

Requirements

The course **TEK5410 Energy Markets and Regulation - Modelling and Analysis** is a prerequisite for the thesis, or the student need to be able to document an equivalent knowledge of modelling.

It is also recommended having taken **TEK5420 Norway's Energy Transitions: Policy Directions and Challenges** and **TEK5350 Energy Markets and Regulation**, although not mandatory.

Relevant literature

Illustration by Tom Brown https://nworbmot.org/courses/esm-2020/lectures/esm-lecture-1.pdf

Drechsler, M., Egerer, J., Lange, M., Masurowski, F., Meyerhoff, J., & Oehlmann, M. (2017). Efficient and equitable spatial allocation of renewable power plants at the country scale. Nature Energy, 2(9), 1–9. https://doi.org/10.1038/nenergy.2017.124

Gross, C. (2007). Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. Energy Policy, 35(5), 2727–2736. https://doi.org/10.1016/j.enpol.2006.12.013

Kverndokk, S., & Rose, A. (2008). Equity and Justice in Global Warming Policy (SSRN Scholarly Paper ID 1273003). Social Science Research Network. https://doi.org/10.2139/ssrn.1273003

Neumann, F. (2021). Costs of regional equity and autarky in a renewable European power system. Energy Strategy Reviews, 35, 100652. https://doi.org/10.1016/j.esr.2021.100652

Sasse, J.-P., & Trutnevyte, E. (2019). Distributional trade-offs between regionally equitable and cost-efficient allocation of renewable electricity generation. Applied Energy, 254, 113724. https://doi.org/10.1016/j.apenergy.2019.113724

Sasse, J.-P., & Trutnevyte, E. (2020). Regional impacts of electricity system transition in Central Europe until 2035. Nature Communications, 11(1), 4972. https://doi.org/10.1038/s41467-020-18812-y

Weinand, J. M., McKenna, R., Heinrichs, H., Roth, M., Stolten, D., & Fichtner, W. (2021). Exploring the trilemma of cost-efficient, equitable and publicly acceptable onshore wind expansion planning. ArXiv:2106.15198 [Econ, q-Fin]. http://arxiv.org/abs/2106.15198

Zeyringer, M., Price, J., Fais, B., Li, P.-H., & Sharp, E. (2018). Designing low-carbon power systems for Great Britain in 2050 that are robust to the spatiotemporal and inter-annual variability of weather. Nature Energy, 3(5), 395–403. https://doi.org/10.1038/s41560-018-0128-x

UiO : Institutt for informatikk
Det matematisk-naturvitenskapelige fakultet

Master Theses: Networks and Media

Carsten Griwodz (griff@ifi.uio.no) and Pål Halvorsen (paalh@ifi.uio.no)

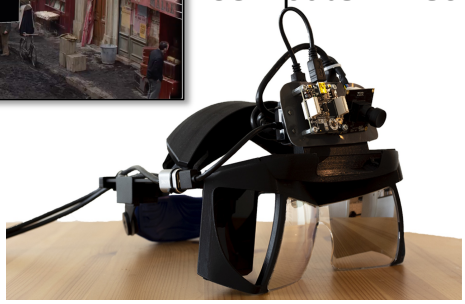
Our **Big Questions** are

How do you use media to communicate and interact over networks?
How can you do it more efficiently?
When is it good enough for users?

AR & VR

How to [.....]

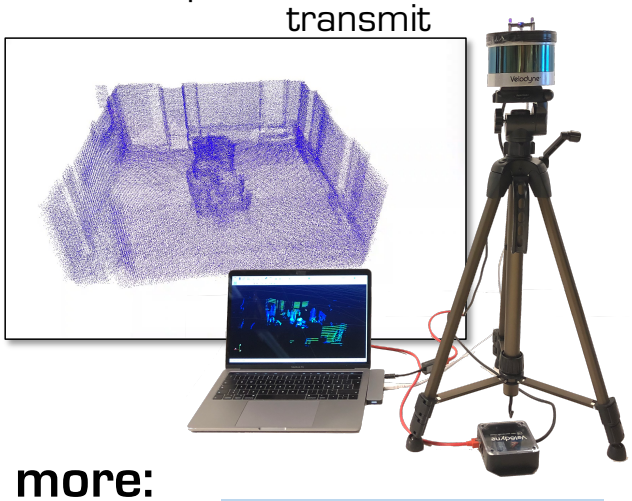
- know user's head and body pose?
- encode motion and pose?
- compress virtual objects efficiently?
- transport virtual objects efficiently?
- minimize transport latency?
- hide transport latency?
- render at the right time?
- render at the right depth?
- compute in real-time?



Point Clouds

How to [.....] them?

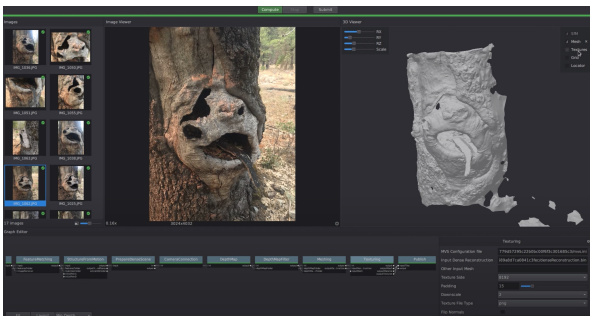
- create
- use
- compress
- understand
- transmit



AliceVision: 3D from photos

How to [.....]

- compute on GPUs?
- compute on clusters?
- use OpenACC for portable speed?



And more:

How to [.....]

- transport 360 video in real-time?
- control network cards' traffic offloading?
- **answer your own question?**
- track data dependencies in a C++ linker?

To learn more, send email to griff@uio.no and arrange a meeting, either at IFI or on Zoom

Heuristic optimization at the Institute of Energy Technology

Institute for Energy Technology (IFE) conducts research for a better future. Since 1948, they have been a frontrunner in international energy research. Digital technology has been part of the research activity at IFE since the 1970s. They doresearch within the energy domain, for the oil and gas industry and the international nuclear industry. Their research methods and results are applicable in other domains as well. The Applied Data Science department at IFE aims at improving the understanding of complex and diverse data to predict equipment failure, optimise production, and enable more informed decision making in all levels of an organisation. The team applies their competences in data analytics, computer science and process modelling.

his thesis may consider one of the optimization problems that IFE is currently investigating and apply heuristic optimization techniques to find good solutions within short computation times. The different optimization problems and some suggested tasks to perform are as follows

1) **Job scheduling in decommissioning:**
   Optimising the scheduling of a set of jobs, carried out in different rooms/areas, by a set of workers with different skills, in a radiation environment.
   a. Parallelisation – testing algorithms to speed
   b. Different strategies – review of algorithms – tabu search tweaking
   c. Multi-objective approach to time, dose rate and cost.
   d. Comparing different implementations with our Java implementation in terms of speed, ease of implementation, extendibility, etc.
2) **Shortest path in radiation environment:**
   A human or drone should visit several locations in a room with obstacles and radiation sources and minimise distance and dose rate.
   a. Visiting several locations (combination with travelling salesman)
   b. Multi-objective – reducing distance, dose rate, number of turns (optimising robot behaviour)
   c. Improving speed and alternative to the A-star algorithm we currently use.
3) **Control room design:**
   A control room is designed to allow for operators to have good working conditions with personal space, walking areas, free sight to displays (personal and overview), etc. A good design is specified in several standards and the task is to find a feasible design (e.g. the position of displays and furniture in 3D space) without breaking any constraints – basically a constraint programming problem.
4) **Circuit board / room / office floor plan layout:**
   Optimising the layout of different components, e.g. circuits on the circuit board, furniture and pipes in a room or work places in an office floor plan.
   a. Multi-objective – optimising for several criteria pipe length, objects, bends, crossing points.
   b. Algorithm review, implementation, and testing.

In addition, it is relevant (for either problem setting) to investigate advanced search strategies. This could involve combinations with machine learning, testing reinforced learning from previous moves. A prerequisite for selecting this topic is to have taken the course LOG734 Heuristics in Analytics, or having equivalent knowledge

External contact: Emil Wingstedt (Emil.Wingstedt@ife.no), https://ife.no/en/

Humans and Automation at the Institute for Energy Technology

Institute for Energy Technology (IFE) conducts research for a better future. Since 1948, they have been a frontrunner in international energy research and digital technology has been part of the research activity at IFE since 1970s. Their research is applied in energy, nuclear, transport, industry, smart city and space domains.

The Humans and Automation department at IFE focus on interaction and teaming between humans and advanced technologies in highly digital and complex environments. Our mission is to understand and demonstrate how humans and advanced technologies can work together to optimize performance and safety.

We propose 2 theses within the area for studying human automation collaboration:

1. **Description**: The projects aim at instrumenting a radio-controlled boat with a small and inexpensive sonar, and study through experiments and data analysis how this sensor platform can be used in search and rescue missions on water. The student should explore the need for autonomous operations. The thesis will mainly consist of 4 parts:
    a. Instrumentation of COTS hardware (boat, sonar, and data collection)
    b. Planning and implementation of practical experiments
    c. Developing software for presentation and analysis of sonar data
    d. Analyzing sensor data and characterizing sensor performance

    Motivation: Fire brigades and other rescue agencies need underwater eyes in search and rescue tasks. Today, visual aids and rescue divers are used in searches for missing persons, which are both time-consuming and provide limited search areas. Using cheap and accessible sonars, the fire brigades can get more tools, potentially saving more lives.

2. **Description**: The project aim is to merge robot navigation/situational awareness and radio coverage for safe teleoperation. Based on the operating environment and robot sensor feed, communication dead-spots can be predicted and avoided. The student should also explore how this information could be presented to an operator (e.g., visual, AR/VR or haptic feedback). Topics related to this master thesis are:
    a. Robot navigation
    b. Radio wave propagation (Wi-Fi, 5G)
    c. Visualization
    d. Human-Machine Interaction

    Motivation: The main motivation for this thesis is to explore how operators interacts and teleoperates robots in complex environments. Safe robot navigation is tightly coupled with radio coverage and understanding of its environments.

IFE invites the students to discuss other thesis projects within our research areas as well.

External contact: Sizarta Sarshar (sizarta.sarshar@ife.no)

UiO : Department of Technology Systems
University of Oslo

Master thesis proposals

ITS: Cybernetics and autonomous systems

Jonas Moen, hjmoen@its.uio.no

ITS 26 October 2021

Examples of thesis topics…

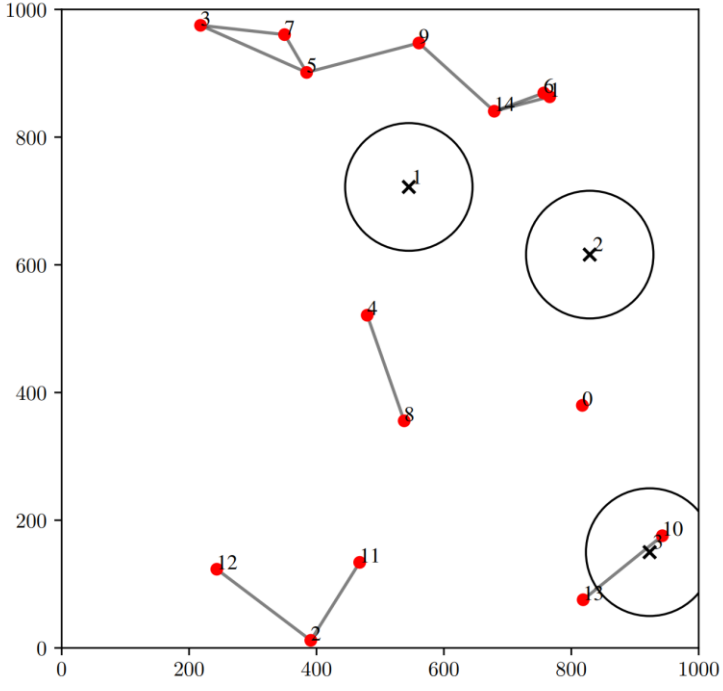
- UAVs for monitoring solar cell plants
- Auctions in multi-robot systems
- 3D modelling using swarm UAVs
- Fault tolerance in swarm systems

- …

UAVs for monitoring solar cell plants

- Optimizing the flight path of swarm UAVs balancing data quality against data acquisition rate
- Complex multiobjective optimization problem
- Applied and theoretical aspects

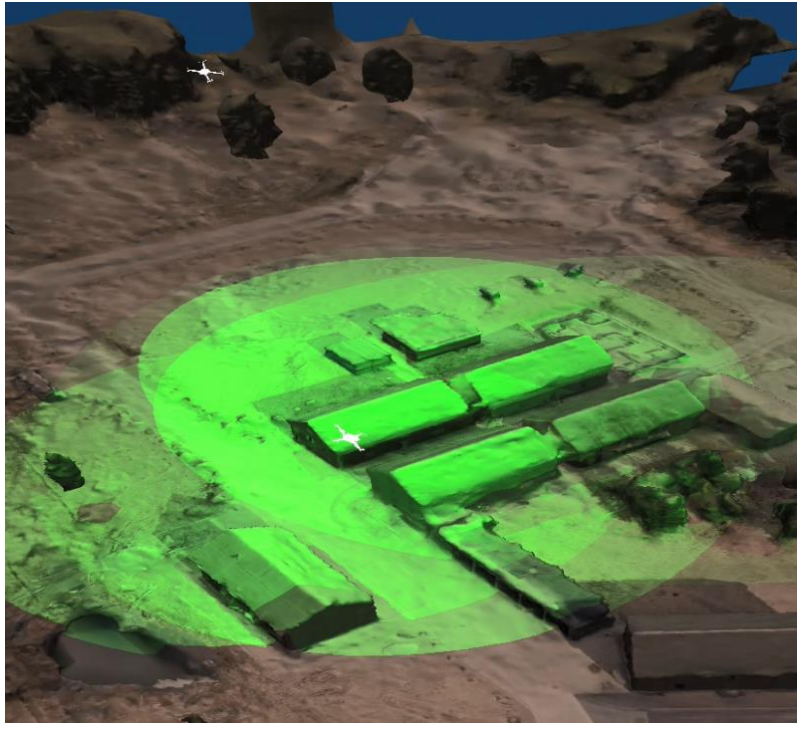
Analysing multi-robot systems



- Multi-robot system performance can be evaluated in benchmark search and task allocation problems (STAP)
- Analyzing different auction mechanisms in simulated multi-robot STAP
- Theoretical assignment

3D modelling using swarm UAVs

- How can we utilize multiple cameras in parallel to do 3D modelling of the environment?
- Anomaly detection at the 3D model level
- Real-world validation using FFI’s swarm UAVs



Summary

- Many master thesis topics possible
- Long or short thesis
- Applied or theoretical focus

- Contact: Jonas Moen, hjmoen@its.uio.no

FFI Norwegian Defence Research Establishment

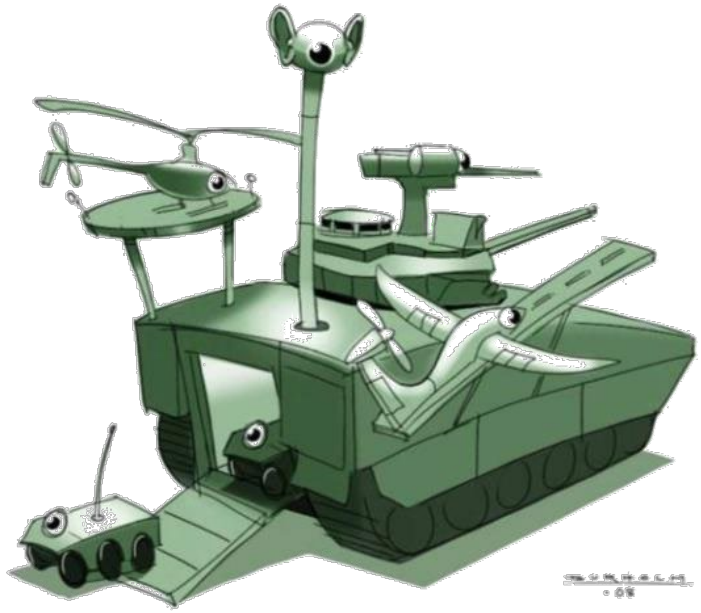
Situational awareness for autonomous systems

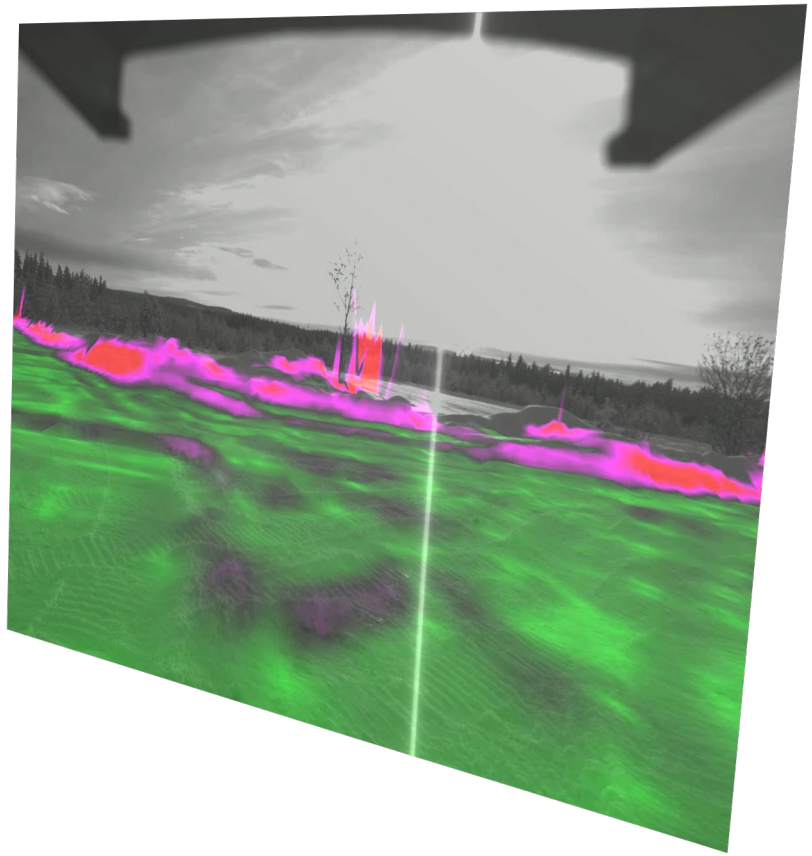
Trym Vegard Haavardsholm
trym.haavardsholm@its.uio.no

Foto: AdobeStock

Situational awareness for autonomous systems

Create situational awareness
from sensor data and other information
for autonomous systems



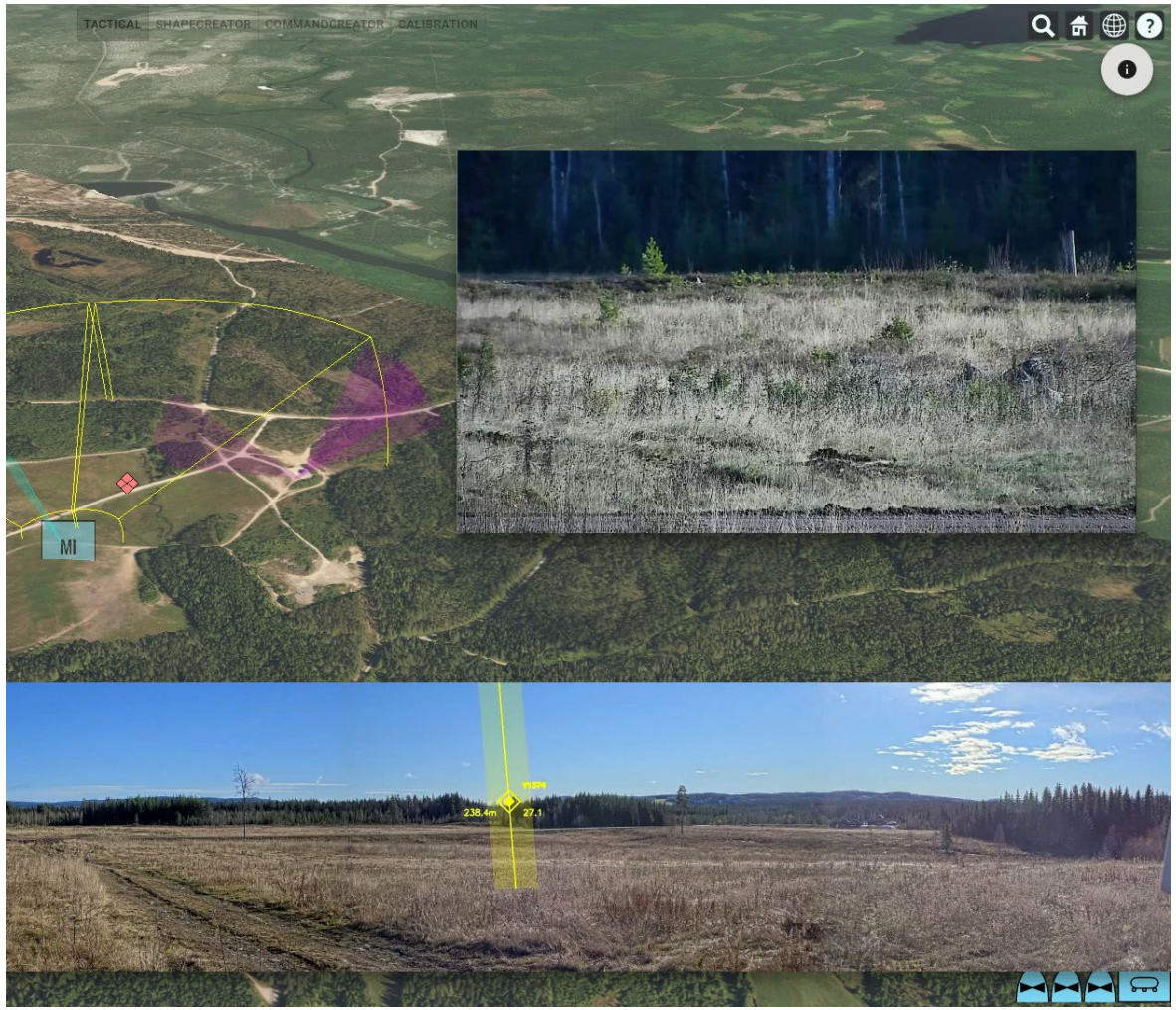


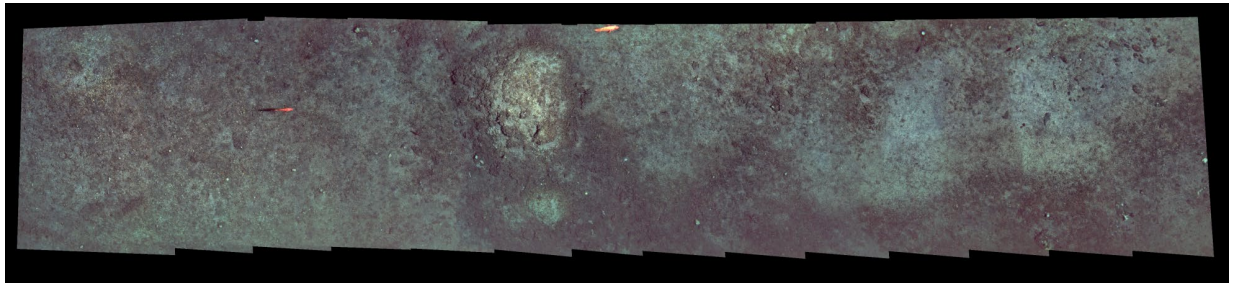
We work with many different autonomous systems

… and use many different types of sensors

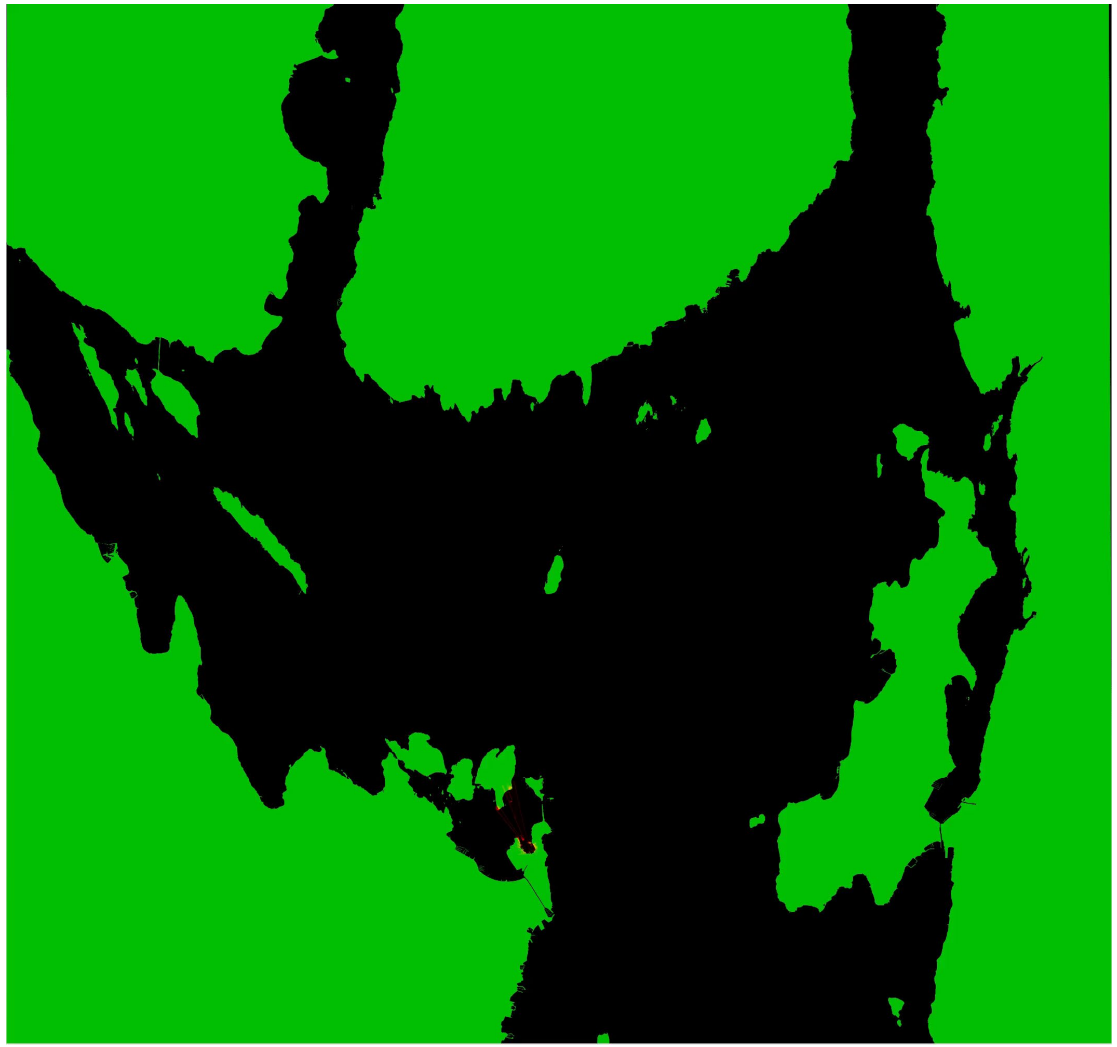
We extract information from sensors

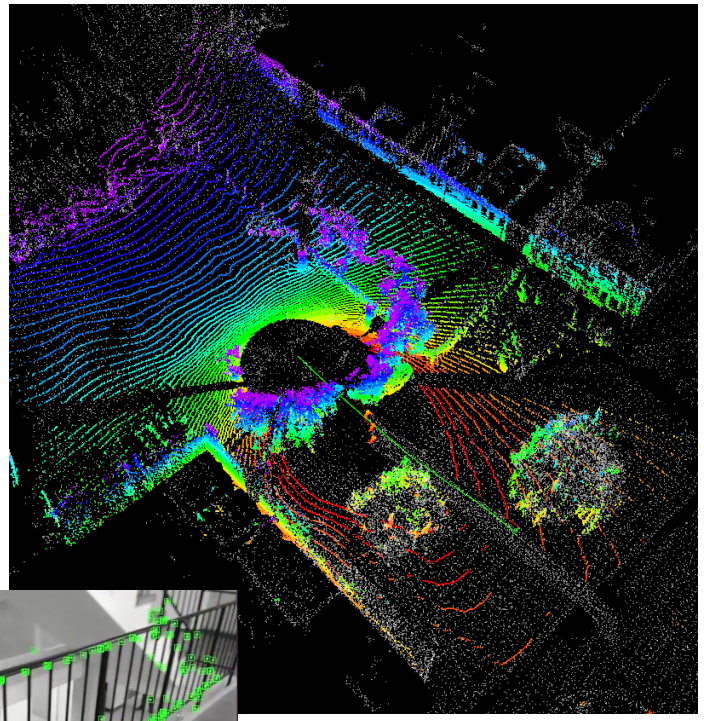
… and we fuse across time, sensors and platforms

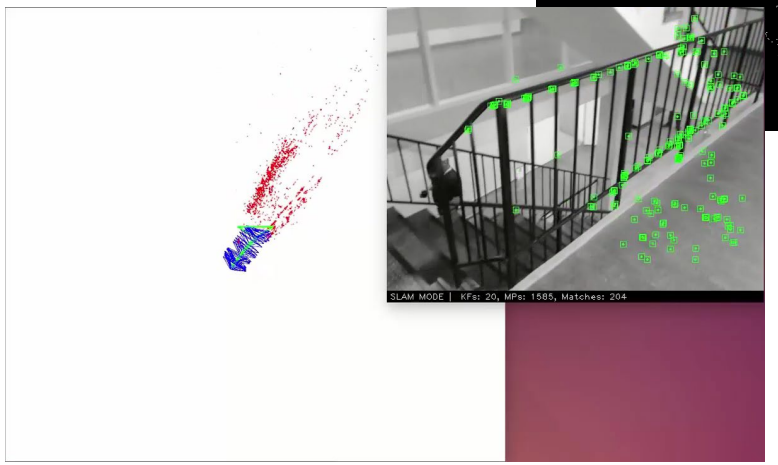




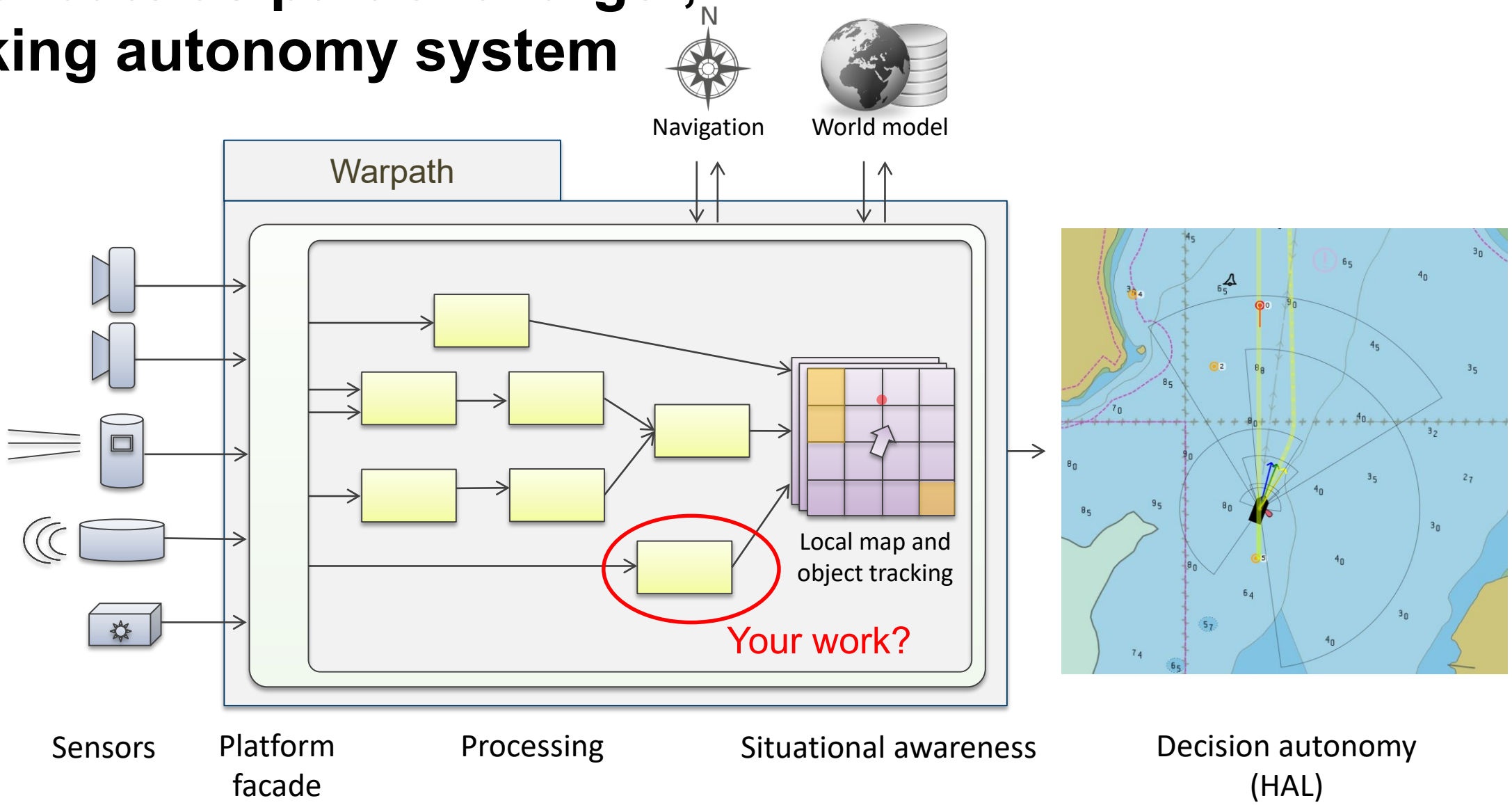
This is better when using these sensors for navigation







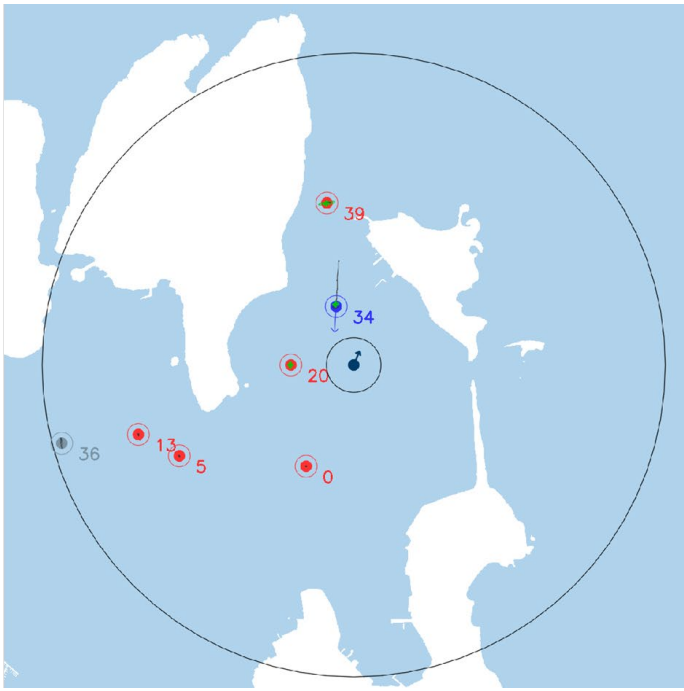
Contribute as part of a larger, working autonomy system



Does any of this sound interesting?

- Then let's have a talk!

trym.haavardsholm@its.uio.no



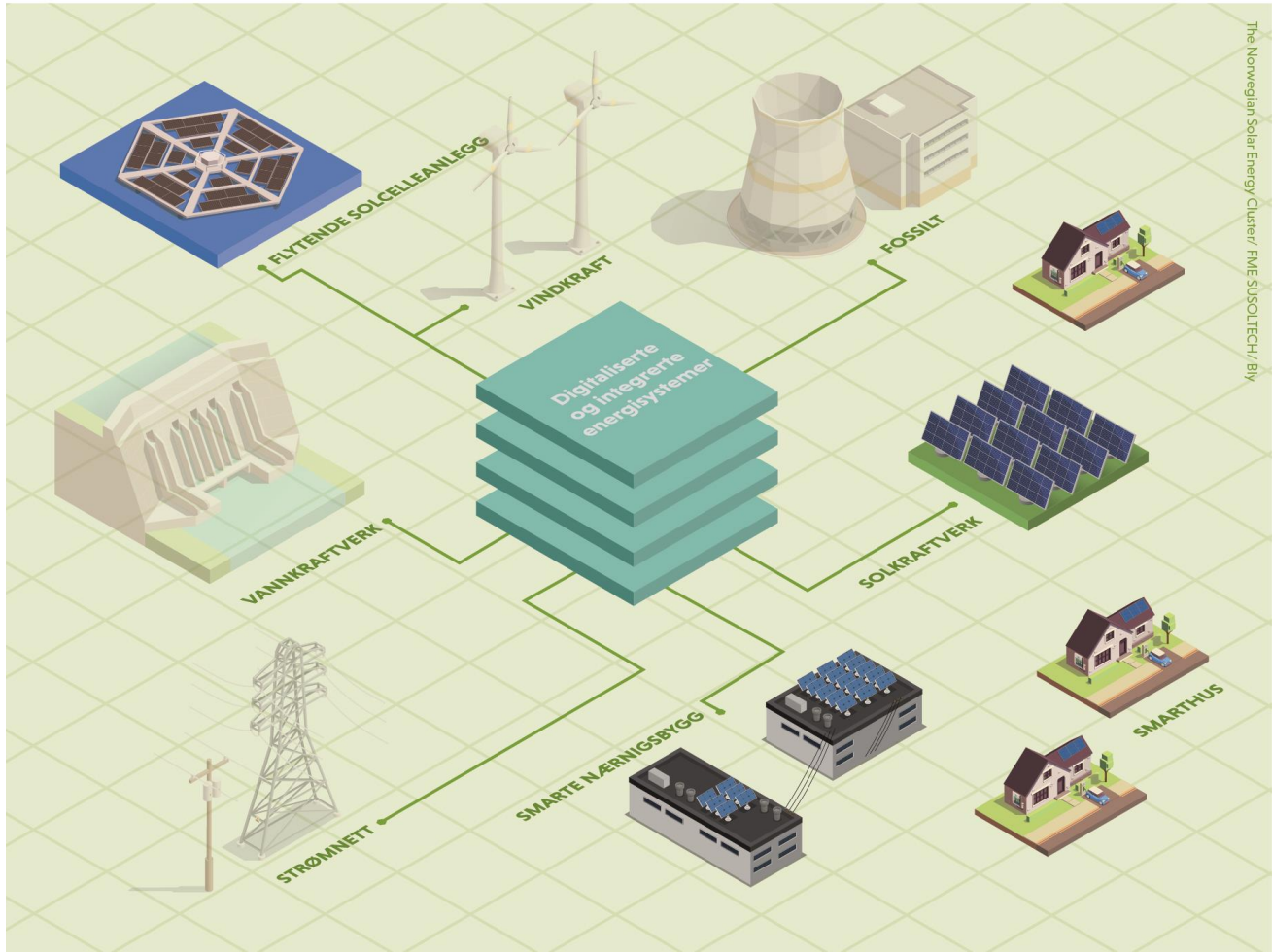
Master student topics at IFE:

PV systems / Renewable energy systems

Erik S. Marstein – Chief scientist IFE, Professor II ITS/UiO

What are we working on at IFE?

- PV cell and module production technology
- PV systems
  - Utility-scale
  - Floating PV
  - Building-integrated systems
  - Digitalization, digitalization, digitalization
- Wind power
  - Offshore wind technology
- Hybrid power plants
  - «Grønn plattform: PV+hydro+battery system»
- Energy systems analysis
- Energy storage
  - Battery storage
  - Hydrogen systems
- And much, much more…



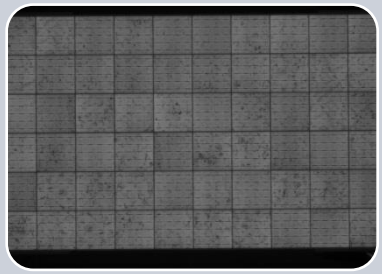
PV systems research at IFE

PV power plants

Building-integrated PV (BIPV)

Commercial PV plants & Smart buildings

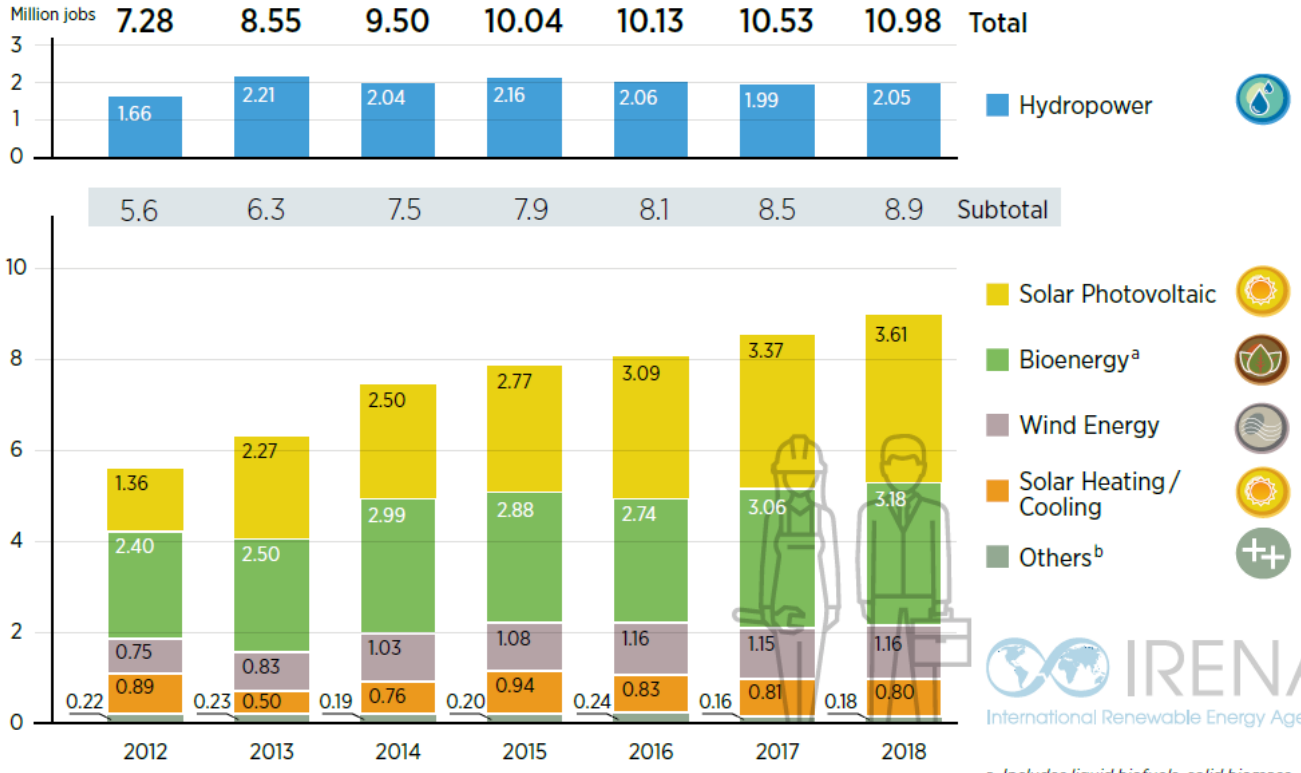
Floating PV (FPV)



Module development & testing

PV?

FIGURE 1: GLOBAL RENEWABLE ENERGY EMPLOYMENT BY TECHNOLOGY, 2012-2018



Source: IRENA jobs database.

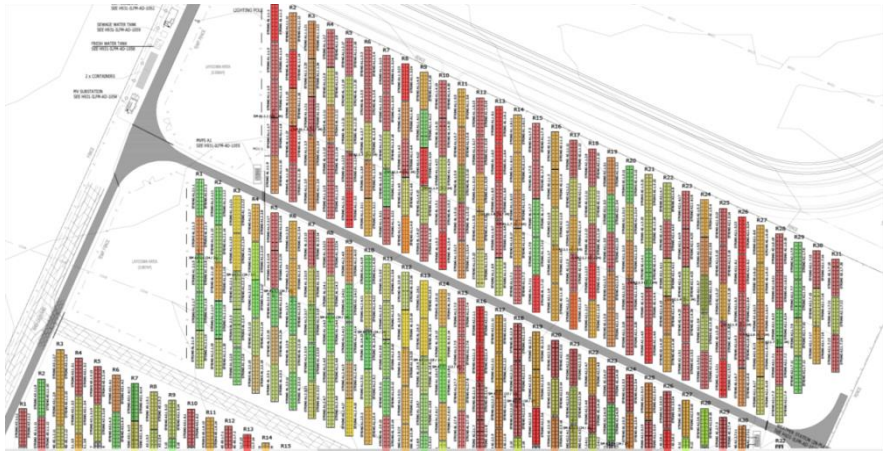
Note: Except for hydropower where a revised methodology led to revisions of job estimates, numbers shown in this figure reflect those reported in past editions of the Annual Review.

a. Includes liquid biofuels, solid biomass and biogas.

b. Other technologies include geothermal energy, concentrated solar power, heat pumps (ground-based), municipal and industrial waste, and ocean energy.

Example topics with students today (M.Sc. / PhD)

- Autonomous drone-based IR thermography of PV power plants
- Fault detection and diagnostics for PV power plants
- Degradation rates in PV power plants
- Reliability of floating PV systems
- Hybrid PV+hydro power plants
- Performance analytics for PV power plants
- Agri-PV systems
- Performance of bifacial PV systems in Norway



- **Track record: > 50 M.Sc students and > 20 PhD students in PV**

What can we offer?

- Depending on topic
  - A COMMITTED research group
  - RELEVANT topics
  - INDUSTRY collaboration
  - STRONG team and competence basis
  - Possibilities for EXCELLENCE
  - Possibilities for IMPACT

Solar Energy 211 (2020) 1255–1262

Contents lists available at ScienceDirect

Solar Energy

journal homepage: www.elsevier.com/locate/solener

How much power is lost in a hot-spot? A case study quantifying the effect of thermal anomalies in two utility scale PV power plants

Åsmund F. Skomedal [a,b,*], Bjørn L. Aarseth [b,a], Halvard Haug [a,b], Josefine Selj [a,b], Erik S. Marstein [a,b]

[a] Institutt for Energiteknikk (IFE), Instituttveien 18, 2007 Kjeller, Norway
[b] University of Oslo, Department of Technology Systems, Gunnar Randers vei 19, 2007 Kjeller, Norway

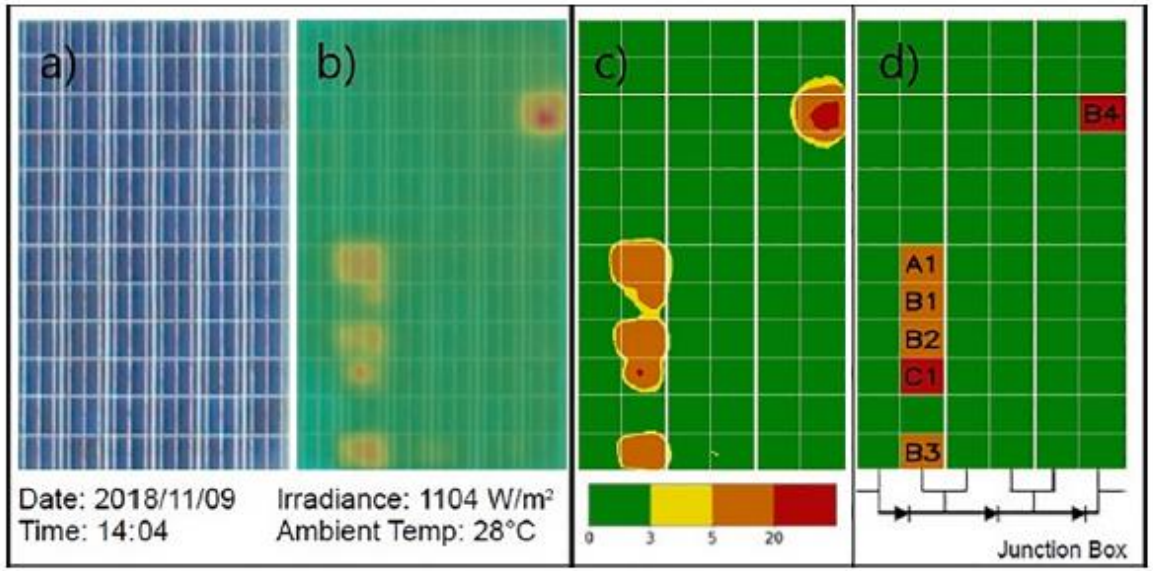


Fig. 1. Example from the IR-report, showing (a) an optical image of a module, (b) an overlay of the optical image and the IR-image, (c) a discretized IR-image, and (d) the categorization of the individual cells according to the categories described in Section 2.2.1.

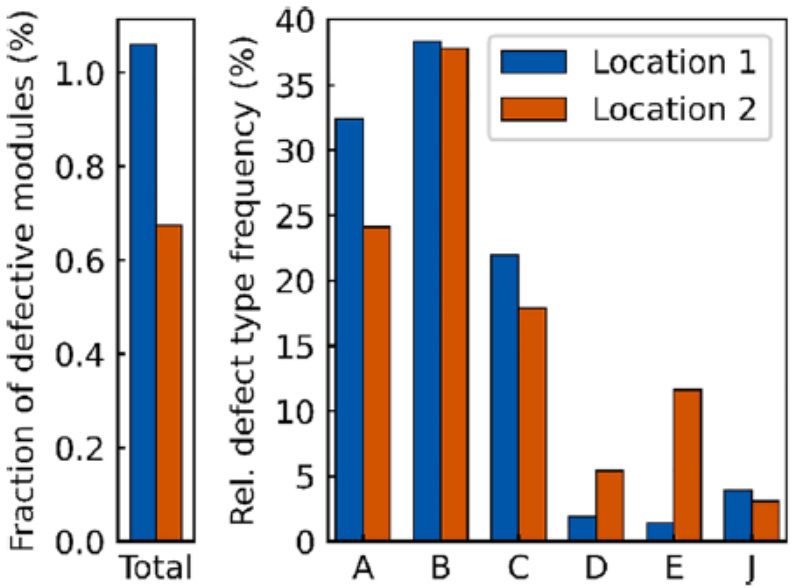


Fig. 3. Number of modules with thermal anomalies relative to the total number of modules (left) and the number of anomalies of each category relative to the total number of defects (right) at the two locations.

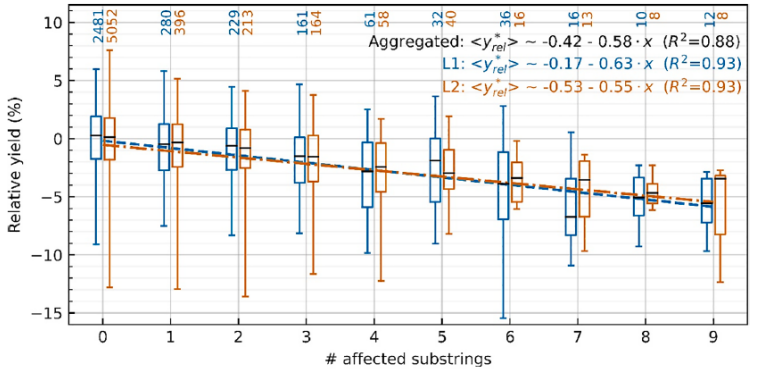


Fig. 4. Average relative yield $\langle y^*_{rel} \rangle$ of the double-strings as it varies with number of module sub-strings with thermal anomalies in the two locations. The boxplots encompass the 25th and 75th percentiles, the horizontal lines show the median values, and the whiskers show the 2.5th and 97.5th percentiles. The numbers close to the top of the plot show how many data-points (each point representing one double-string) are represented in each respective x-value. The trend lines are obtained by ordinary least squares regression based on all data points in each location, and, in the case of the aggregated value, on all data points from all locations combined.

IF thesis in PV systems…

…broad possibilities:

- Utility-scale PV power plants
  - Includes bifacial PV, agri-PV, FDD +++
- Floating PV power plants
- Building-integrated PV systems
- Hybrid PV-X power plants

…lets discuss to see if/where you fit in!

Master thesis topics within energy system analysis

- If interested contact pernille.seljom@ife.no
- Associate Professor at ITS – lecturer in TEK5340 Energy system analysis: Modelling, methods and scenarios
- Senior researcher at Institute for Energy Technology (IFE)
- Master thesis will be supervised by one of my colleagues or myself that works with renewable energy system analysis

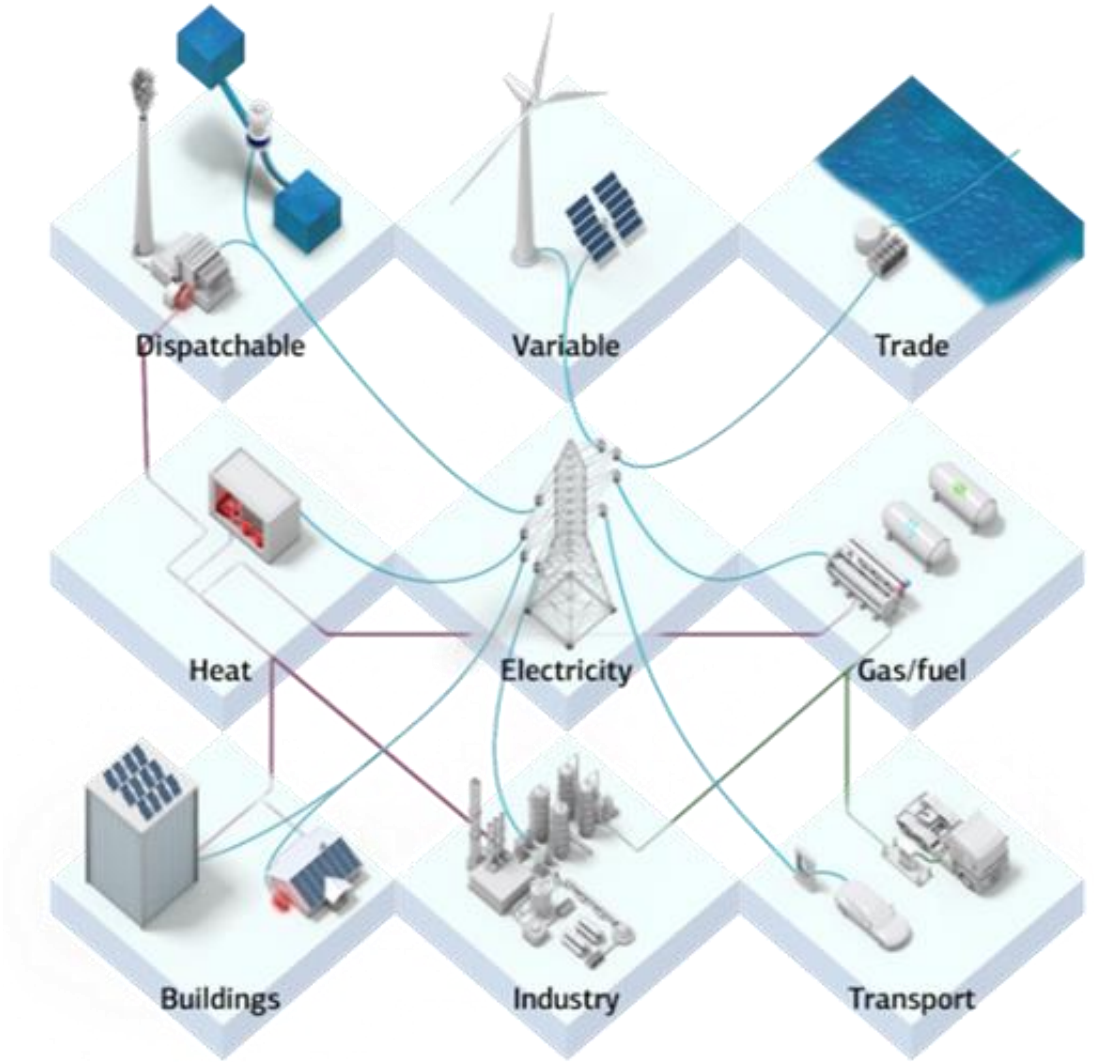


Figure: IEA, NETP 2016

New green industries in Norway

Opportunities, barriers & energy system impact

New green industries in Norway, such as battery factories, hydrogen production and data centers

- What are the drivers for investments?
- What is the energy demand and how can they be integrated to the energy system?
- What is the possible pathways for new green industries in Norway?
- What is the impact of green industries on the Norwegian power sector?

Role of biomass and biofuels in the Norwegian low carbon transition

The Norwegian bio resources can be used in multiple ways to lower the climate gas emissions in several sectors.

- What are the different technology options and their techno-economic characteristic?
- Where can bio be used in the Norwegian energy system and what technologies should be used?
- What is the impact of bio use on Norwegian energy system and emissions?
- What are the different pathways for bio in the Norwegian low carbon transition?

Hydrogen production and offshore wind production - Optimization, Design & Economics

- Techno-economic modelling of one or several cite specific cases by making an optimization model in a suitable language
- Analysis of optimal design and profitability
- Research question: Under what conditions are offshore wind and hydrogen production a business case?

Thanks for your attention!

Erik Stensrud Marstein
eriksm@ife.no

UiO : Department of Technology Systems
University of Oslo

Master Projects – Topics

Supervisor: Matylda N. Guzik, PhD

Senior Lecturer

Kjeller, 26th October, 2021

Hi, I'm Matylda. I've met some of you during the Hydrogen Technology course but for those, who do not know me yet …

- I'm a materials scientist & a crystallographer
- I have 15+ years of extensive experience in studies of functional materials/components, as well as sustainable solutions for energy production, conversion & storage technologies
- My research is based on experimental studies & is highly interdisciplinary
- My office at ITS is on the second floor (room no. 208)
  Feel free to visit!
  I have a very comfortable armchair and good tea ☺

UiO : Department of Technology Systems
University of Oslo

Norway grants | Iceland Liechtenstein Norway grants | HERA

TOPIC I: Hydrogen from Sunlight

Photoelectrochemical hydrogen production & storage – a single technology for two processes

- **YOUR** work will be a part of the **HERA applied research** project
  Hydrogen Energy Rechargeable Architectures: Coupling of On-demand Hydrogen Generation & Storage

- **YOU** will join **the HERA team** to design & develop a portable device for on-demand photoelectrochemical hydrogen production & storage

- Together with me (project PI), Yuan-Chih Lin (postdoctoral researcher) & Sabrina Sartori (collaborator), **YOU** will participate in the design of a (photo)cathode in the mentioned device, based on the hydrogen storage materials. **The work will involve lots of experimental activities in our new renewable energy storage laboratory!**

- Since this work is done in collaboration with the Center of New Technologies (CeNT) at the University of Warsaw (project coordinator) & a company InPhoCat (our industrial partner), **YOU** will have a chance to join the interdisciplinary discussions & visit the project partners

MORE on HERA - https://www.mn.uio.no/its/english/research/projects/hera/index.html

UNIVERSITY OF WARSAW | CeNT | InPhoCat

TOPIC II: Clean Water & CCS – a hidden link

Minerals formed during the CO_2 sequestration (e.g., Dypingite) can also absorb heavy metals and serve as water purifiers

- **YOUR** activity will be done as a part of the **NATSORB applied research** project *DYPINGITE - A Superior Natural Sorbent for Management of Heavy Metal Water Pollution?*
- **YOU** will join **the interdisciplinary NATSORB team** to design & develop a filter technology for sequestration of heavy metals from water. Filters will be based on DYPINGITE, a naturally occurring mineral, very abundant in Norway
- Together with me, our two postdoctoral researchers & mineralogists/geologists from UiO, **YOU** will investigate & optimize the functional performance of natural & synthetic minerals for the water filter technology
- **YOU** will work in labs at ITS, Natural History Museum, SINTEF, NIVA, and University of Munster. There will be a chance for scientific discussion and travel!

MORE on NATSORB - https://www.nhm.uio.no/english/research/projects/natsorb/index.html

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TOPIC III: The Second Life of the Waste Scooter Batteries

Finding new applications for waste batteries from Lime scooters, together with our industrial partner Yedlik AS

- **YOUR** activity will be a part of the **EMPOWER** project
  Sustainable Batteries in Mobility - (Em)powering a Net-zero Energy Transition

- **YOU** will join **the super-multidisciplinary EMPOWER team** to test properties of waste scooter batteries and to find new ways of using them

- Together with me, Marianne Zeyringer (project leader), our PhD/postdoctoral researchers, **YOU** will learn what is needed to give the used batteries the second life. You will test performance of used Lime scooter Li-ion batteries in these new second-life applications

- **YOU** will work in a close collaboration with our industrial (Yedlik AS) and academic (Aalborg University) partners

MORE on EMPOWER - https://www.mn.uio.no/its/english/research/projects/empower/index.html

YEDLIK

AALBORG UNIVERSITET

If you find these projects interesting, or would like to know more about them, or would like to join one of the research teams, **let's talk**!

I. You can find me in my office at ITS: **room no. 208 (ITS / 2nd floor)**

II. You can also send me an email: **matylda.guzik@its.uio.no**

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University of Oslo

Lars Erling Bråten

Adjunct Professor - Section for Autonomous Systems and Sensor Technologies

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Visiting address
Gunnar Randers vei 19
2007 KJELLER

Postal address
Postboks 70
2027 KJELLER

- Software Defined Radio
- Radio and satellite communication systems

Download business card

20% position at ITS.

Lars Erling Bråten is employed as Professor II at the Department of Technology Systems (ITS). He works on radio- and satellite communication systems and give lessons in satellite communications. His main research interest is currently utilisation and design of of micro satellites for communications solutions for the High North.

Tags: Radio systems, High North, Communications, Micro satellites

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Sabrina Sartori

Associate Professor - Section for Energy Systems

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Academic Interests

Solid state physics and chemistry including synthesis and characterisation of materials for energy storage. Structure characterisation via *in-situ* synchrotron radiation and powder neutron diffraction performed at large scale facilities, for instance at the European Synchrotron Radiation Facility (ESRF) of Grenoble (France), at the Canadian Institute for Neutron Scattering (CINS) of Chalk River (Canada) and at Oak Ridge National Laboratory (ORNL), USA. Investigation of nanoscale and porous materials with small-angle neutron and X-ray scattering (SANS and SAXS).

Head of Energy storage systems group.

Available master thesis topics suggested by Sabrina Sartori

Available

- Energy storage system design for a sustainable telescope in Chile (Current EU project AtLAST https://www.atlast.uio.no/)
- Development of 2D material as anode for solid-state Li-ion battery (Bilateral project https://eeagrants.org/archive/2014-2021/projects/PL-Basic%20Research-0026)
- Energy storage system design for a floating wind turbine, in collaboration with a Norwegian company (UNITECH)
- Investigation of scaling up of an innovative photocatalytic hydrogen production device

Other topics where energy storage is a component could be formulated according to the students´ interest.

Example of past topics:
Please see the topics described here:
https://www.mn.uio.no/its/english/research/energy%20storage%20systems/