

Roboat

World's Leading Robotic Sailboat

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InnoC.at

roboat



Who are we?

InnoC.at

**AUSTRIAN
SOCIETY
FOR
INNOVATIVE
COMPUTER
SCIENCE**

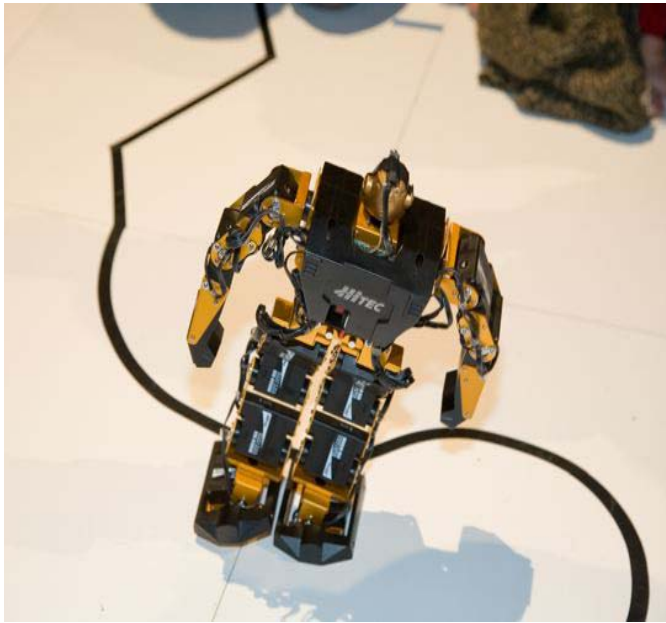
WWW.INNOC.AT



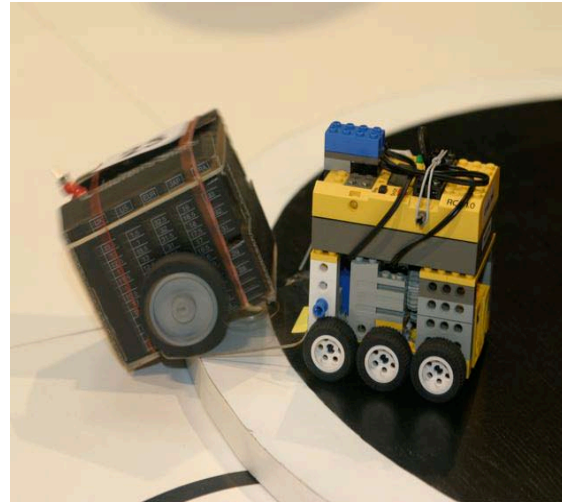
- Since 2005
- ~ 50 members
- Non-profit research organisation in Vienna
- Motivation of comers for science and technology
- Provide infrastructure
- Network of experts

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From Robot to Roboat



www.robotchallenge.org



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What is a robotic sailboat?



Sails without any human intervention!

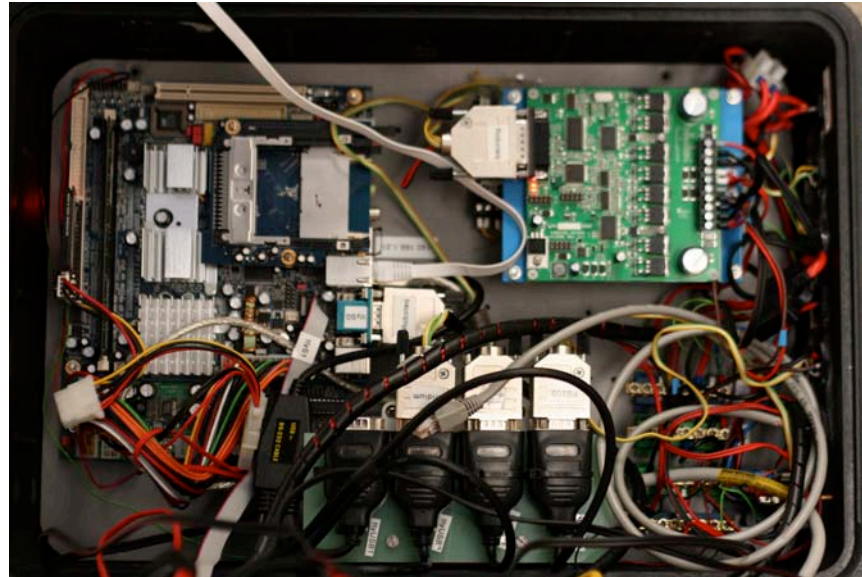
- Weather routeing
- Autonomous tacking and jibing
- Emergency strategies

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Roboat Technology

Sensors

- GPS
- Compass
- Heel
- Wind



Actuators

- Rudder
- Sails

“Artificial Sailor”
layered architecture

roboat

International Competitions

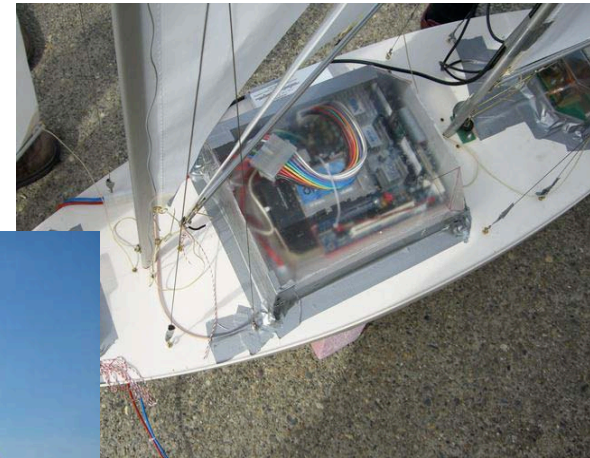
- 06/2006: First Microtransat in France
- 09/2007: Second Microtransat in Wales
- 05/2008: World Robotic Sailing Championship in Austria
- 06/2009: World Robotic Sailing Championship in Portugal

www.roboticsailing.org

www.microtransat.org



Microtransat 2006 in Toulouse/France



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Final tests at Microtransat 2006
Toulouse – France



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Microtransat 2007 in Aberystwyth/Wales



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24h race at Microtransat 2007
Wales – Irish Sea



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World Robotic Sailing Championship 2008 in Breitenbrunn/Austria



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World Robotic Sailing Championship 2008
Lake Neusiedl – Austria



World Robotic Sailing Championship 2009 in Porto/Portugal



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World Robotic Sailing Championship 2009
Porto - Portugal



Boat characteristics

- length: 3,75 m
- total displacement: 300 kg
- Sailarea : 3 m² + 1.5 m²
- self-righting design

Computer

- Mini-ITX with Linux
- 800MHz / 512MB RAM
- 4 GB CF Card
- Control software in Java and C++

Communication

- WIFI
- GPRS/UMTS
- Iridium satellite modem

Sensors

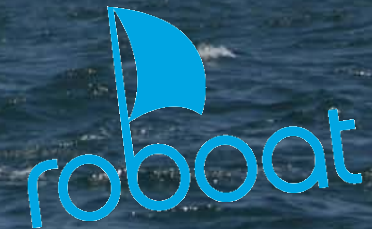
- position and speed over ground (GPS)
- speed through water
- battery voltage and power consumption
- ultrasonic wind sensor (direction and speed)
- tilt-compensated compass (heading and heel)
- humidity, air and water temperature, air pressure, depth

Actuators

- sheet linear drive
- tiller linear actuator
- automatic bilge pump
- horn, lights

Energy balance

- 50W avg. power consumption
- 1,5m² solar panels (285Wp)
- 4.6 kWh lithium ion batteries



„ASV robot“ at a Glance

Why Robotic Sailboats?



- Intelligent sensor buoys
- Safety on sailing yachts
- CO₂-neutral cargo transportation
- Surveillance & searching
- Boat as sailing trainer
- Convenience on board


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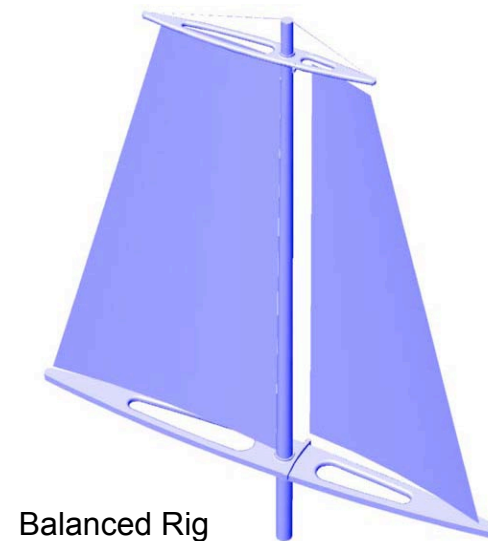
Future Challenges

- The boat has to operate **energetically autonomously** for long time.
- The boat has to **detect obstacles** reliably.
- The boat has to **avoid obstacles** reliably.



Energy Balance

- Power Sources
 - Solar Panels (285 W peak, ~ 35 W avg.), unlimited
 - Direct Methanol Fuel Cell (65 W), duration limited to approx. 4 weeks
- Power Consumption (~ 35 W avg.)
 - Onboard PC ~ 15 W
 - Sensors and further electronic components ~ 10 W
 - Rudder < 1 W
 - Sails ~ 10 W
- Save Energy
 - Low Power PC ~ 3 W
 - Low Power Electronics ~ 6 W
 - Sails: **Balanced Rig** ~ 3 W
 - Optimize Control System (can save up to 50 % for rudder and sail actuator)



Goal: **less than 15 W power consumption** to have energy for further scientific equipment.



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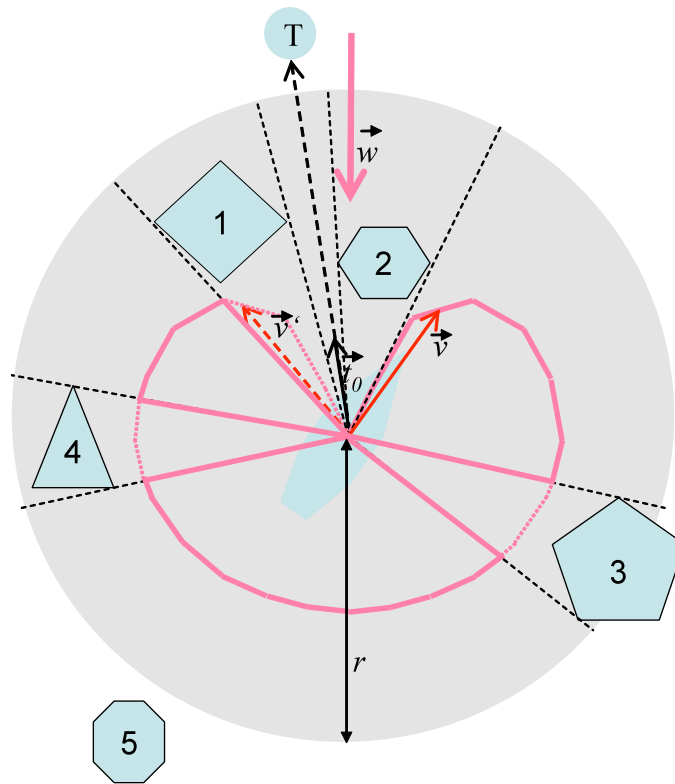
Obstacle Detection

- **Static obstacles** (landmasses etc.) are defined in sea maps and can be considered during routing process.
- **Dynamic obstacles** (ships, icebergs, etc.) have to be detected in real time.
 - **Combination of different techniques**, such as
 - Radar
 - Thermal imaging
 - Camera
 - Laser range scanner
 - Automatic Identification System (AIS)



Obstacle Avoidance

Boat polar speed diagram is the basis for the short course routing system.



T ... target
1 – 5 ... obstacles
w ... wind
t, t0 ... (unit) vector to target
grey circle ... radar scan area
v' ... optimum without obstacles
v ... optimum considering obstacles
r ... radius of scanner range

Obstacles:
2 ... no influence because in no-go zone
5 ... no influence because out of scanner range
1, 3, 4 ... „cut“ polar
1 ... influence on route because original route through obstacle 1

obstacle detected -> modify polar diagram -> efficiency of routes towards obstacles decrease -> routing algorithm decides for alternative (navigable) routes

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AAS Endurance – Marine mammal research



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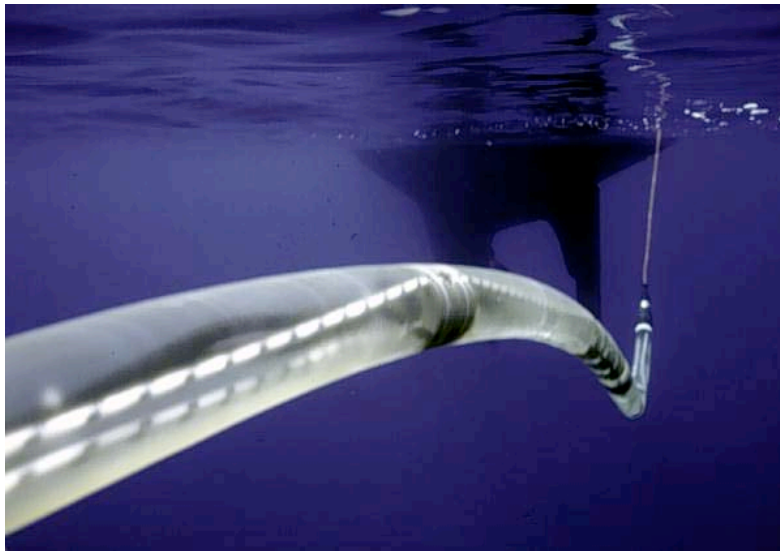


Image source: www-1.unipv.it/cibra

Autonomous Acoustic Sailboat (AAS)
Towed array behind AAS Endurance



Image source: earth.google.com

The logo for "roboat", featuring a stylized blue sailboat icon above the word "roboat" in a blue, lowercase, sans-serif font.

Questions?



Further Information

www.roboat.at – our „ASV roboat“

roland.stelzer@innoc.at – for questions

Thank you for your attention!

