Robotics
JACOBS UNIVERSITY

The "Game" of Science

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Game of Science

like in any game

- there are rules
- regarding cheating ("disqualification")
- and how to "score"
- as well as ways to practice and to improve yourself

How to avoid getting "disqualified"

Risk of "Disqualification"

always obey good scientific practice

- zero tolerance w.r.t. plagiarism
- documentation of results
- observing professional standards
- ethical issues (e.g., informed consent, …)

Risk of "Disqualification"

- ***Plagiarism!!!***
  - do not c&p from others
  - paraphrasing does not help; it makes things even worse (criminal energy)
  - when using / referring to previous work
    - use proper references (see also later)
    - mark quotes "…" (plus *italics* or…) and try to only use only short quotes (not long paragraphs)
    - clearly state own and others contributions
- Self-Plagiarism
  - (excessive) re-use of own material across several publications / seminar papers / course work / etc.
  - references and clear statements ("as already pointed out by us in [X]") can help

Risk of "Disqualification"

- documentation of results
  - ***make sure that you backup your data!!!***
  - ***make sure that the results are reproducible (backup your code)!!!***
  - keep personal copies and make sure that it is in addition kept in the lab you work(ed) in
  - German Science Foundation (DFG) e.g. requires that data & code is kept for at least ***10 years***
- professional standards
  - proper statistics, proper experimentation, comparison to the state of the art, …
  - also strongly enforced through peer review for publications

Risk of "Disqualification"

ethical issues: example EU proposal
(just for information; typically not a concern for a robotics BSc)

ETHICAL ISSUES TABLE

	YES	PAGE
Informed Consent		
• Does the proposal involve children?	NO	
• Does the proposal involve patients?	NO	
• Does the proposal involve persons not able to give consent?	NO	
• Does the proposal involve adult healthy volunteers?	YES	34 (T2.4) 39 (T5.2, T5.3)
Biological research		
• Does the proposal involve human genetic material?	NO	
• Does the proposal involve human biological samples?	NO	
• Does the proposal involve human biological data collection?	YES	34 (T2.4), 39 (T5.2, T5.3)
• Does the proposal involve human embryos?	NO	
• Does the proposal involve human foetal tissue or cells?	NO	
• Does the proposal involve human embryonic stem cells?	NO	
Privacy		
• Does the proposal involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)	NO	
• Does the proposal involve tracking the location or observation of people without their knowledge?	NO	
Research on Animals		
• Does the proposal involve research on animals?	NO	
• Are those animals transgenic small laboratory animals?	NO	
• Are those animals transgenic farm animals?	NO	
• Are those animals cloned farm animals?	NO	
• Are those animals non-human primates?	NO	
Research Involving Third Countries		
• Is any part of the research carried out in countries outside of the European Union and FP7 Associated states?	NO	
Dual Use		
• Does the research have direct military application	NO	
• Does the research have the potential for terrorist abuse	NO	
ICT Implants		
• Does the proposal involve clinical trials of ICT implants?	NO	
I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL		

Section 4. Ethical Issues

For the development of our models we will collect video, sonar and physiological data from divers. Divers will also be used to interact with the underwater vehicles, without getting into contact with them. These divers will be **adult healthy volunteers** or **hired professional divers**. All the data collection will be performed using non-invasive techniques so there is no danger for the divers during these experiments. These experiments consist of divers performing usual operations in water while being recorded. We will follow the Helsinki protocol in our procedure. Prior to participation, participants will be informed about

1. the purpose of the research, expected duration, and procedures;
2. their right to decline to participate and to withdraw from the research once participation has begun;
3. the foreseeable consequences of declining or withdrawing (which will be none in our case);
4. reasonably foreseeable factors that may be expected to influence their willingness to participate such as potential risks, discomfort, or adverse effects;
5. any prospective research benefits;
6. limits of confidentiality (i.e. data will be made available to the consortium);
7. incentives for participation; and
8. whom to contact for questions about the research and research participants' rights.

We will provide opportunity for the prospective participants to ask questions and receive answers. Information will be provided both written and verbally. After answering all questions, subjects will provide informed consent by signing a document. Non-participation will not have negative consequences.

In the CADDY project, WP6 is devoted to diver safety and regulation issues – within this work package additional effort will be devoted towards divers during the phase of experiments and trials.

Data will be **completely anonymous**, i.e. no personal data will be collected beyond the recordings. Data will be number-coded so it will not be possible to connect them with a specific person.

The data collection and experiments with divers will take place in swimming pools provided by DAN Europe (who are experts in diver operations). The field trials that will include experiments will take place in Murter, Croatia, a diver-friendly area.

Prior to the experiments and field trials taking place, the procedure will be submitted to the local **ethical committee** for approval. Both DAN Europe and UNIZG-FER have ethical committees who will be in charge of dealing with any ethical issues that may arise, regarding the diver operations during the CADDY project.

How to do "Science"

The basic loop

- get an idea of the problem and of the state of the art (i.e., read)
- start with a – or even the most – simple approach (typically based on the state of the art or even "below")
  - may do already the job
  - gives a baseline for comparisons
- formulate and test a hypothesis
  - design experiments: consider what the critical variables are (robotics: HW, SW, "environment")
  - carefully test the influences of the critical variables (principle of "*ceteris paribus*" - "all other things being equal" - while keeping its limits in mind)
  - do proper statistics (mean, variance, significance)
- identify limits and open issues
  - go back to the start of the loop (or more precisely: the spiral ☺)
- write up (ideally continuously)

Literature Search
(know the state of the art)

Online Resources

- IEEE Xplore
- ACM Portal
- Google Scholar
- Researchgate
- Science Citation Index (SCI)
- Scopus

(Jacobs is very good in this respect)

Online Resources

- IEEE Xplore
  - http://ieeexplore.ieee.org/search/advsearch.jsp
  - the ultimate source for EE and robotics publications, very good for CS
  - very good search engine
  - full text access (i.e., you have access to an incredible nice digital library)
  - all IEEE journal articles and conference papers
  - access from all computers within the JACOBS network (not from the outside; JACOBS has to pay for this digital library)
  - easy to do proper citations of the publications

Online Resources

- ACM Portal
  - http://portal.acm.org/portal.cfm
  - good source for CS, but also quite some EE and robotics publications
  - easy to do proper citations of the publications
  - unfortunately no full text access (only some publications can be directly downloaded as PDF)
  - to get a publication that is not available online, it has to be ordered via the InterLibraryLoan ILL (http://www.jacobs-university.de/library/services/ill) of the IRC

Online Resources

- Google Scholar: http://scholar.google.com/
- Researchgate: https://www.researchgate.net/
  - advantage: huge collections; often full papers as PDF
  - advantage: often good links to related work
  - disadvantage: you have to check what is a "real" publication and what is not; some material on there is just white papers, preprints, etc.
  - disadvantage: to do proper citations of these papers, you have to double check where the paper really appeared; you can not use the http-link to Google Scholar or Researchgate as a reference

Online Resources

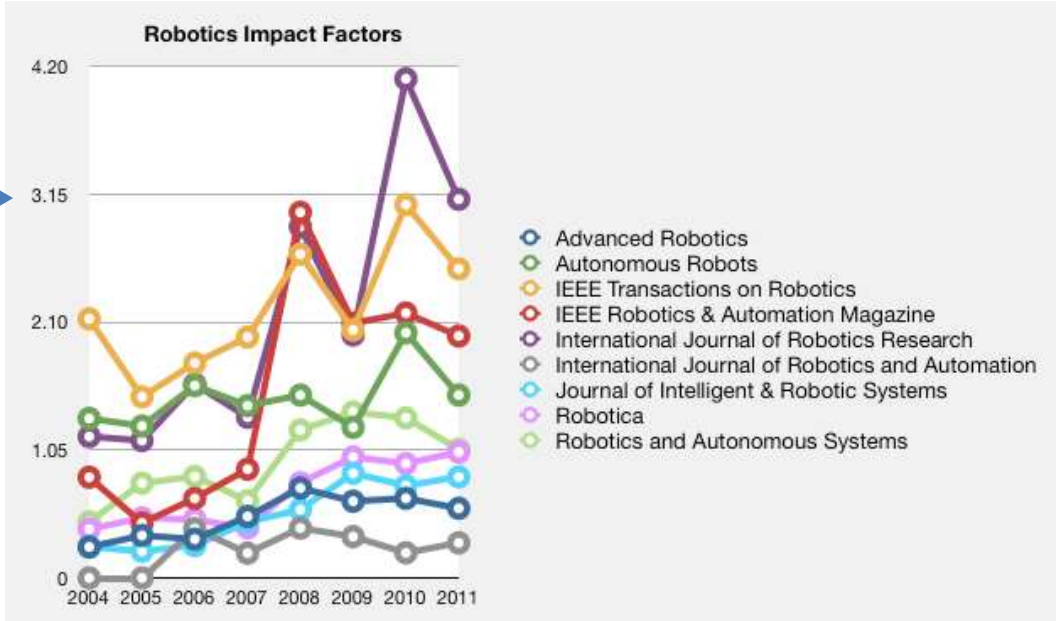
- Science Citation Index (SCI)
  - http://apps.webofknowledge.com
  - the source of information on how "important" publications are
  - lists publications and how often they are cited from "prestigious" sources
  - covers all scientific fields
  - mainly journals only!!!
- Scopus
  - similar to SCI but with "CS/engineering"-touch, especially including the important conferences

Impact

- naive: count citations
  - of single papers
  - or of journals, conferences on average
- H-index
  - n publications with at least n citations
  - to avoid the problems of the average
  - properly computed by SCI; but PoP (publish or perish, http://www.harzing.com/pop.htm) popular tool based on Google scholar

What is "important" literature

- rough ranking
  - journal article > conference paper > workshop
- rankings by source impact
  - slightly dynamic
  - robotics journals
  - AI & rob. conf.,
  - esp. ICRA & IROS
  - also MS ranking
- paper impact



Links to top robotics sources

Journals

1. International Journal of Robotics Research (IJRR)
2. Journal of Field Robotics (JFR)
3. IEEE Transactions on Robotics (ITRO)
4. IEEE Robotics and Automation Magazine (RAM)
5. Autonomous Robots (AuRo)

Conferences

1. IEEE International Conference on Robotics and Automation (ICRA)
2. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
3. Robotics Science and Systems (RSS)

Notes

- ICRA & IROS papers plus ITRO & RAM articles are included in IEEE Xplore
- the other journals (IJRR, JFR, AuRo) have all different publishers
- it can't hurt (or even be fun ☺) to regularly look at the top journals

Scientific Writing & References

Proper References

- Using a bibliography
- Using keys
- What to cite
- Images, illustrations, etc.
- Acknowledgements

Using a bibliography

- properly list any source
- for presentations: references e.g. as footnote (or in the end)
- written reports: a special section called "Bibliography" or "References"
- provide all information to trace the source
  - at least: author(s), title, where published (which conference/journal), when
  - typically also page numbers, publisher, etc.
- standard formats for the bibliography
  - e.g., APA style (APA = American Psychological Association) http://www.lib.monash.edu.au/tutorials/citing/apa.html
  - IEEE style www.ijsst.info/info/IEEE-Citation-StyleGuide.pdf
- proper references are easy with Latex plus Bibtex (http://en.wikipedia.org/wiki/Bibtex)
  - use the proper reference types!!! (@article{}, …)
  - Bibtex can use different styles like APA or IEEE

Example Bibtex

```
@article{ESA-LRC-JFR12,
  author = {Belo, Felipe A. W. and Birk, Andreas and Brunskill, Christopher and Kirchner, Frank and Lappas, Vaios and Remy, C. David and Roccella, Stefano and Rossi, Claudio and Tikanmäki, Antti and Visentin, Gianfranco},
  title = {The ESA Lunar Robotics Challenge: Simulating Operations at the Lunar South Pole},
  journal = {Journal of Field Robotics},
  publisher = {Wiley},
  volume = {29},
  number = {4},
  pages = {601-626},
  year = {2012}
}

@inproceedings{SpectralUnderwaterSLAM-ICRA12,
  author = {Pfingsthorn, Max and Birk, Andreas and Bülow, Heiko},
  title = {Uncertainty Estimation for a 6-DoF Spectral Registration method as basis for Sonar-based Underwater 3D SLAM},
  booktitle = {International Conference on Robotics and Automation (ICRA)},
  publisher = {IEEE Press},
  year = {2012}
}

@article{MultimodalGraphSLAM-IJRR12,
  author = {Pfingsthorn, Max and Birk, Andreas},
  title = {Simultaneous Localization and Mapping (SLAM) with Multimodal Probability Distributions},
  journal = {The international Journal of Robotics Research},
  abstract = {Simultaneous Localization and Mapping (SLAM) has focused on noisy but unique data associations resulting in linear Gaussian uncertainty models. However, a unique decision is often not possible using only local information, giving rise to ambiguities that have to be resolved globally during optimization. To solve this problem, the pose graph data structure is extended here by multimodal constraints modeled by mixtures of Gaussians (MoG). Furthermore, optimization methods for this novel formulation are introduced, namely (a) robust iteratively reweighted least squares, and (b) Prefilter Stochastic Gradient Descent (SGD) where a preprocessing step determines globally consistent modes before applying SGD. In addition, a variant of the Prefilter method (b) is introduced in form of (c) Prefilter Levenberg–Marquardt. The methods are compared with traditional state-of-the-art optimization methods including (d) Stochastic Gradient Descent and (e) Levenberg–Marquardt as well as (f) Particle filter SLAM and with (g) an optimal exhaustive algorithm. Experiments show that ambiguities significantly impact state-of-the-art methods, and that the novel Prefilter methods (b) and (c) perform best. This is further substantiated with experiments using real-world data. To this end, a method to generate MoG constraints from a plane-based registration algorithm is introduced and used for 3D SLAM under ambiguities.},
  year = {2012}
}
```

Bibliography & DOI

- Digital Object Identifier (DOI)
  - e.g., 10.1177/0278364912461540
  - or, doi: 10.1177/0278364912461540
- unique ID to retrieve a paper
  - http://www.doi.org/
  - unlike URL, etc. the DOI never changes
- DOI and bibtex
  - use field doi!!! (doi = …,)
  - do ***not use any own hacks***!!!

Using keys

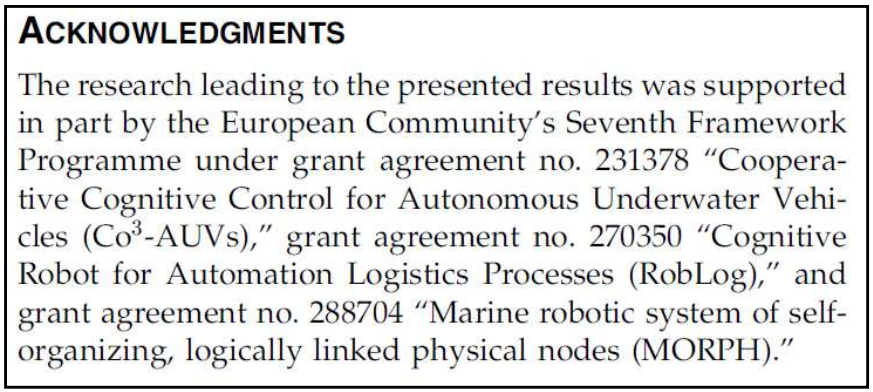
- key = shortcut to a reference in the bibliography
- two main versions
  - numbers (e.g. [1] Alonso Adam, Bibi Blocksberg, Joe Cool; The Art of Partying; Funny Books Publisher; 2001)
  - initials of the authors' last names plus year of appearance (e.g. [ABC01] Alonso Adam, Bibi Blocksberg, Joe Cool; The Art of Partying; Funny Books Publisher; 2001)
- keys with bibtex automatically generated
  - according to the used style (apa, IEEE, …)
  - using \cite{} command (\cite{MultimodalGraphSLAM-IJRR12})

What to cite

- any part of your contribution
  - relying on an external source must be marked
  - it is not sufficient to just list the sources in the bibliography.
- use of some information or idea from a source
  - but stated in your own words
  - it is nevertheless a must to cite the source
  - this can be done for example as follows: 'Getting a good party going is according to [1] an artform'.
- any literal quote from any source must be clearly marked
  - typically by quotation marks
  - this can range from a few words to a large paragraph
  - the source is typically listed at the end of the quote, e.g., "blah blah blah blah party blah blah blah blah blah blah " [1]
  - in any case, the source must be clearly related to the quote

Acknowledgements

- if some people, institutions, etc. contributed
  - in some way that does not fit into the bibliography
  - then it is appropriate to include an acknowledgement section or slide at the end
- this includes especially fellow students or other people who significantly helped you
- this also includes cases where there is project funding (DFG, EU, …)



ACKNOWLEDGMENTS

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