Some Structured Comments about PhD Supervision

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EEE

That's what we want: successful and happy graduates

With five of my graduates at Spring Graduation, 28 Sep 2010

I am supervising MSc and PhD students since the 1970s at different universities in Germany (Jena, TU Berlin, Göttingen, Tübingen), in 1996-2014 at UoA (and Shanghai Jiao Tong), since 2015 at AUT

I started in pure Mathematics, but moved into **interdisciplinary research** quite early after my PhD, about end of the 1970s:

- "intelligent microscopes" - with Carl Zeiss Jena
- parallel data processing and image analysis
- expert systems for medical image analysis
- geometric algorithms for image analysis, computer vision, robotics
- computer vision and 3D shape recovery
- medical 3D image analysis
- panoramic vision and laser range finders - with DLR Germany
- shortest path algorithms in Euclidean space
- vision-based driver assistance - with Daimler A.G.
- environmental surveillance (track reading)
- non-photorealistic rendering

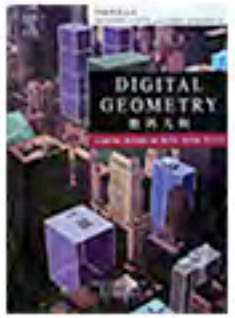
Books

Books with former PhD students

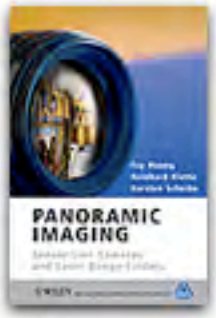
2016

2014

2011



2009
(China edition)



2008

2004

1998

1996

1996

1995

1992

1989

1989

1985
(Slovak edition)

PART I: My quick list of important factors

1. An interesting (main) subject
2. A team is of benefit (... necessary)
   weekly research meetings (e.g., seminars)
3. Provide a high-quality research infrastructure
4. What counts are **results** in research
5. International experience and presence
6. Stimulation of creativity, diversity, fun, ...

PART II: Also subjects for my presentation today

1. Research proposal writing
2. Exploring different ways of supervising
3. Defining the research context
4. Experiment design
5. Thesis writing

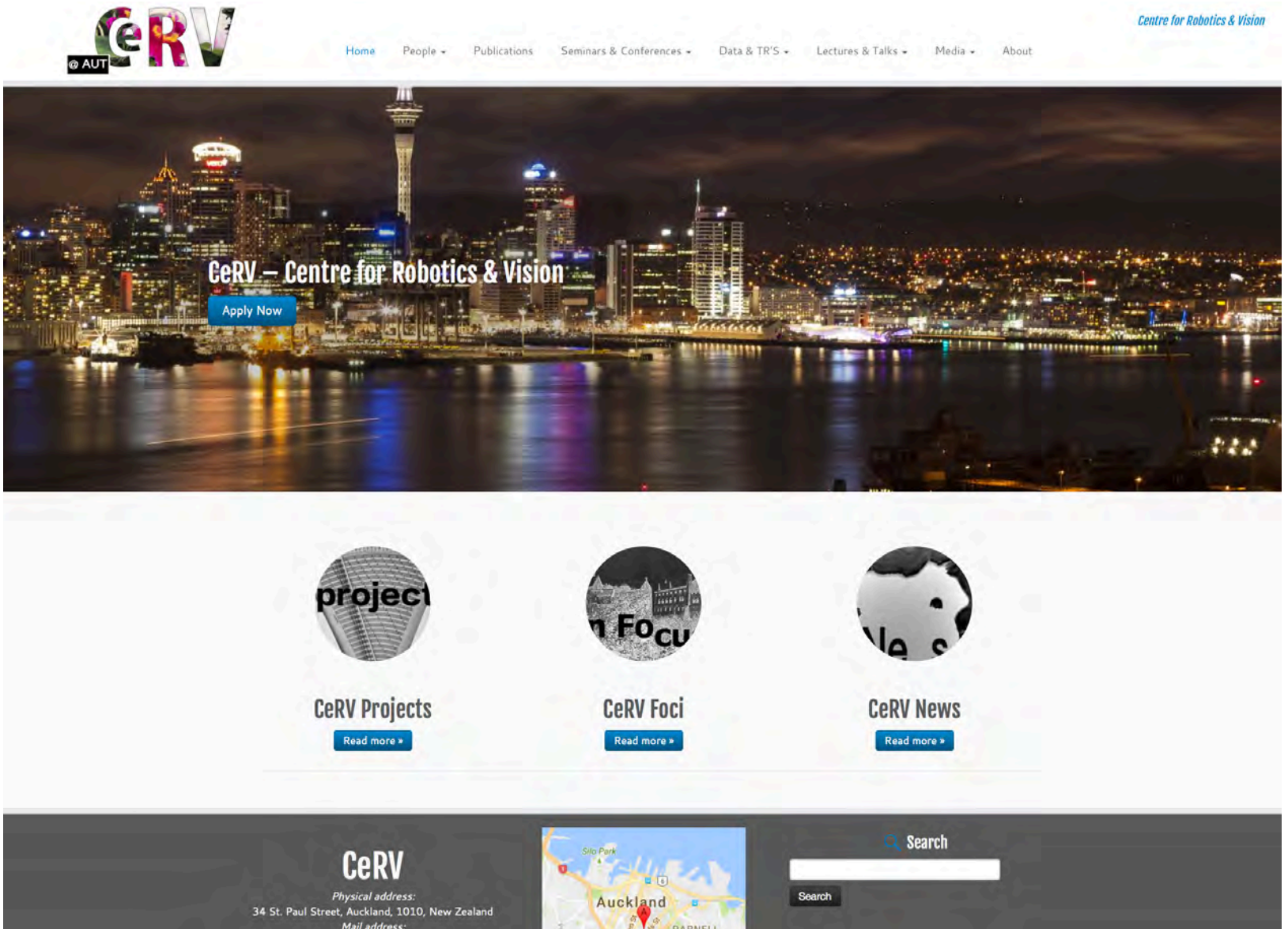
1. An interesting (main) subject:

Identify an important subject that combines theoretical with hands-on challenges, in the (current or future) area of expertise of the supervisor.

In this talk I illustrate for vision-based driver assistance, one of my current research subjects (just to have an example).

Vision-based driver assistance applies one or multiple cameras (possibly in combination with LIDAR, GPS, etc.) for understanding the dynamic environment of a car.

- More than one academic staff member in the subject
- Publicity (to attract good students via the net)
- Defined way of contact for national or international students



Starting in a PhD program is quite a difficult procedure for an international student, often it starts with an

1. **Expression of interest** on a graduate student website; then waiting for approval
2. find potential supervisor and prepare **research proposal** (in contact with potential supervisor)
3. submit to **PhD committee**, see some graduate student website for details
4. **approvals**, also by faculty and university graduate student office
5. apply for **scholarships** in New Zealand (faculty, VC, …)
6. have **PhD visa** approved to NZ (this may take several months! I had up to 10 months so far)
7. discuss starting date, possibly more options for scholarship applications, ...

This might be already too complex.

Only 10-20 % of those reaching 3 make it to a start

2. A team is of benefit

Exchange of information between students is often very efficient.
Teamwork towards joint publications
Joint experiments, a fair competition to identify best models, algorithms, ...
...

Members and visitors of CeRV, 16 June 2015

CeRV Retreat at Whatipu

Members and visitors of CeRV, 16 June 2015

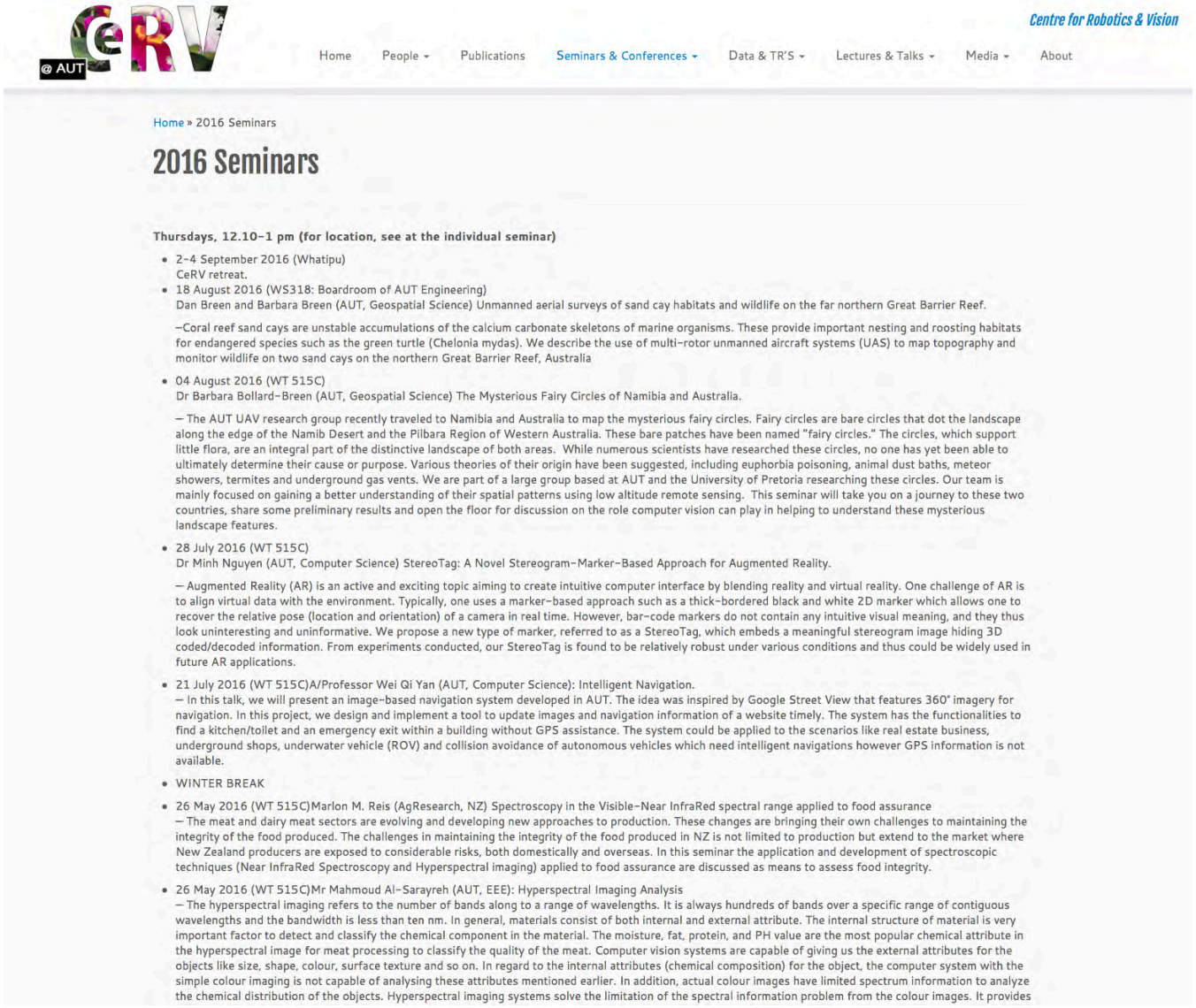
Weekly research meetings

in labs, seminars, one to one, ...

in an atmosphere of trust, but also of quality

tell a student if a presentation was not good

PhD student: one seminar (45 min) 1-2 times a year



@ AUT CeRV

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Home » 2016 Seminars

2016 Seminars

Thursdays, 12.10–1 pm (for location, see at the individual seminar)

- 2–4 September 2016 (Whatipu)
  CeRV retreat.
- 18 August 2016 (WS318: Boardroom of AUT Engineering)
  Dan Breen and Barbara Breen (AUT, Geospatial Science) Unmanned aerial surveys of sand cay habitats and wildlife on the far northern Great Barrier Reef.

  –Coral reef sand cays are unstable accumulations of the calcium carbonate skeletons of marine organisms. These provide important nesting and roosting habitats for endangered species such as the green turtle (Chelonia mydas). We describe the use of multi-rotor unmanned aircraft systems (UAS) to map topography and monitor wildlife on two sand cays on the northern Great Barrier Reef, Australia
- 04 August 2016 (WT 515C)
  Dr Barbara Bollard-Breen (AUT, Geospatial Science) The Mysterious Fairy Circles of Namibia and Australia.

  – The AUT UAV research group recently traveled to Namibia and Australia to map the mysterious fairy circles. Fairy circles are bare circles that dot the landscape along the edge of the Namib Desert and the Pilbara Region of Western Australia. These bare patches have been named "fairy circles." The circles, which support little flora, are an integral part of the distinctive landscape of both areas. While numerous scientists have researched these circles, no one has yet been able to ultimately determine their cause or purpose. Various theories of their origin have been suggested, including euphorbia poisoning, animal dust baths, meteor showers, termites and underground gas vents. We are part of a large group based at AUT and the University of Pretoria researching these circles. Our team is mainly focused on gaining a better understanding of their spatial patterns using low altitude remote sensing. This seminar will take you on a journey to these two countries, share some preliminary results and open the floor for discussion on the role computer vision can play in helping to understand these mysterious landscape features.
- 28 July 2016 (WT 515C)
  Dr Minh Nguyen (AUT, Computer Science) StereoTag: A Novel Stereogram-Marker-Based Approach for Augmented Reality.

  – Augmented Reality (AR) is an active and exciting topic aiming to create intuitive computer interface by blending reality and virtual reality. One challenge of AR is to align virtual data with the environment. Typically, one uses a marker-based approach such as a thick-bordered black and white 2D marker which allows one to recover the relative pose (location and orientation) of a camera in real time. However, bar-code markers do not contain any intuitive visual meaning, and they thus look uninteresting and uninformative. We propose a new type of marker, referred to as a StereoTag, which embeds a meaningful stereogram image hiding 3D coded/decoded information. From experiments conducted, our StereoTag is found to be relatively robust under various conditions and thus could be widely used in future AR applications.
- 21 July 2016 (WT 515C)A/Professor Wei Qi Yan (AUT, Computer Science): Intelligent Navigation.
  – In this talk, we will present an image-based navigation system developed in AUT. The idea was inspired by Google Street View that features 360° imagery for navigation. In this project, we design and implement a tool to update images and navigation information of a website timely. The system has the functionalities to find a kitchen/toilet and an emergency exit within a building without GPS assistance. The system could be applied to the scenarios like real estate business, underground shops, underwater vehicle (ROV) and collision avoidance of autonomous vehicles which need intelligent navigations however GPS information is not available.
- WINTER BREAK
- 26 May 2016 (WT 515C)Marlon M. Reis (AgResearch, NZ) Spectroscopy in the Visible-Near InfraRed spectral range applied to food assurance
  – The meat and dairy meat sectors are evolving and developing new approaches to production. These changes are bringing their own challenges to maintaining the integrity of the food produced. The challenges in maintaining the integrity of the food produced in NZ is not limited to production but extend to the market where New Zealand producers are exposed to considerable risks, both domestically and overseas. In this seminar the application and development of spectroscopic techniques (Near InfraRed Spectroscopy and Hyperspectral imaging) applied to food assurance are discussed as means to assess food integrity.
- 26 May 2016 (WT 515C)Mr Mahmoud Al-Sarayreh (AUT, EEE): Hyperspectral Imaging Analysis
  – The hyperspectral imaging refers to the number of bands along to a range of wavelengths. It is always hundreds of bands over a specific range of contiguous wavelengths and the bandwidth is less than ten nm. In general, materials consist of both internal and external attribute. The internal structure of material is very important factor to detect and classify the chemical component in the material. The moisture, fat, protein, and PH value are the most popular chemical attribute in the hyperspectral image for meat processing to classify the quality of the meat. Computer vision systems are capable of giving us the external attributes for the objects like size, shape, colour, surface texture and so on. In regard to the internal attributes (chemical composition) for the object, the computer system with the simple colour imaging is not capable of analysing these attributes mentioned earlier. In addition, actual colour images have limited spectrum information to analyze the chemical distribution of the objects. Hyperspectral imaging systems solve the limitation of the spectral information problem from the colour images. It provides

3. Provide a high-quality research infrastructure

a true challenge for superviors, not only in New Zealand

options: university or governmental agencies, but also grants from the industry, ..., partnership agreements

make best use of **already existing resources**

let the supervisor (academic) decide

There are inexpensive options for high-quality experiments.

Students have very valuable ideas - listen to them.
Equipment may be borrowed.

Driver assistance on the mobile phone

4. What counts are RESULTS in research

not a nice time together, not reports on "ongoing work", not something what "comes later"

value results high in the team, as the "good example"

Hsiang-Jen Chien: 3D roadside reconstruction (see article in NZ Herald)

Example for sharpening the "focus" of the students

awards for RESULTS

if no high-quality result then ... NO award

Akira Nakamura Award

This award will go to that student who is the

first to forward to Professor Klette an email that she/he has an accepted paper (with being the leading author)

at one of the five **leading 2017 computer vision conferences**, being

CVPR, ICCV, ECCV, CAIP, or PSIVT.

(There is no ACCV in 2017.)

The goal is to go to the top, nothing less

i.e., world class conferences, journals, ...

Examples in my field:

ICCV, ECCV, ACCV, workshops at those, IEEE PAMI, IJCV, ...

(well – there is always a backup plan ...)

There are many (questionable) rankings of conferences or journals - a research group needs to establish its **own classification:** "top", "very good", "nice achievement", ...

5. International experience

We need to be creative in a world of limited travel/conference funds.

CeRV managed to be in charge fore these two conferences, organised at UoA, but by AUT staff, and CeRV students free participants as "helpers”

CeRV @ PSIVT and IVCNZ 2015

IVCNZ: one keynote (Dr. Breen), co-chair (Dr. Stommel), 1 oral, 2 posters
– IEEE, "Best Poster Award"

PSIVT: co-chair (Prof. Klette), one invited (AP GholamHosseini), 3 oral, 6 posters
– all LNCS !

6. Stimulation of creativity, diversity, fun, ...

Not only one main subject in the group, also others

Encourage thinking "out of the square”

Help to develop critical views of students

on research publications (or submissions)

Be open to follow ideas or suggestions by students

Listen to the students - have time for them

PART II: More subjects for my presentation today

1. Research proposal writing
2. Exploring different ways of supervising
3. Defining the research context
4. Experiment design
5. Thesis Writing

1. Research proposal writing

a. Check out interests at a meta level

theory - application - system implementation - some mix of those
- keen to do mathematics - not afraid of mathematics - research history

b. Does the student have an idea to where to go?

default: unexperienced - needs guidance - tell about difference between plagiarism and citations (very important to avoid issues)

c. Balance between independent and guided proposal writing

it needs to be her/his proposal at the end; a good starting point to request a critical view on developments in a field

2 pages would be fine for me, just the significant points, clearly stated

A Word document is fine. Most important: a real challenge has been identified.

Committee's preferences: many pages, e.g. along lines as the following

Subject for PhD program

1. Intro (motivation, context, ...)
2. Objectives
3. Literature review
4. Research methodology
   - Possible approaches to the proposed problem
   - Constraints that must be taken into account
5. Program schedule for the first year, goals
6. Budget
7. References

Committees don’t check again after the student is in the program.

2. Exploring different ways of supervising

a. Regular meetings or communication via email

working under "pressure" is of help: deadlines for a seminar, a report, a conference submission, ... - 3 years is the goal (if research environment already properly established)

b. Obviously, students are different

some don't like too much of interference, others really need very close supervision, especially in the first few months

c. Keep a balance between independent and guided research

quality input (general and particular) is **needed** from a supervisor

"*structured advice*": today we focus on ...

the student has to contribute, propose, define directions, ...

request regular progress towards the final thesis (e.g., in Latex)

3. Defining the research context

a. There needs to be a significant theoretical component

research is about new principles, “theories”, or generalizations, typically to be verified by experiments and compared with other developments

b. There may be experiments at the beginning

understanding the practical issues in the area of research is of basic importance for going towards theoretical contributions

c. In my field it is: theory proposal - testing - adjust theory - ...

computer vision is engineering; there are too many degrees of freedom in the real world for modelling everything

4. Experiment design

a. Cost and time efficient, and focused on accompanying theory

Theoretical studies come first, experimental evaluation second

Borrowed high-tech equipment is ok, team work, ...

b. Detailed planning of experiments (group meetings)

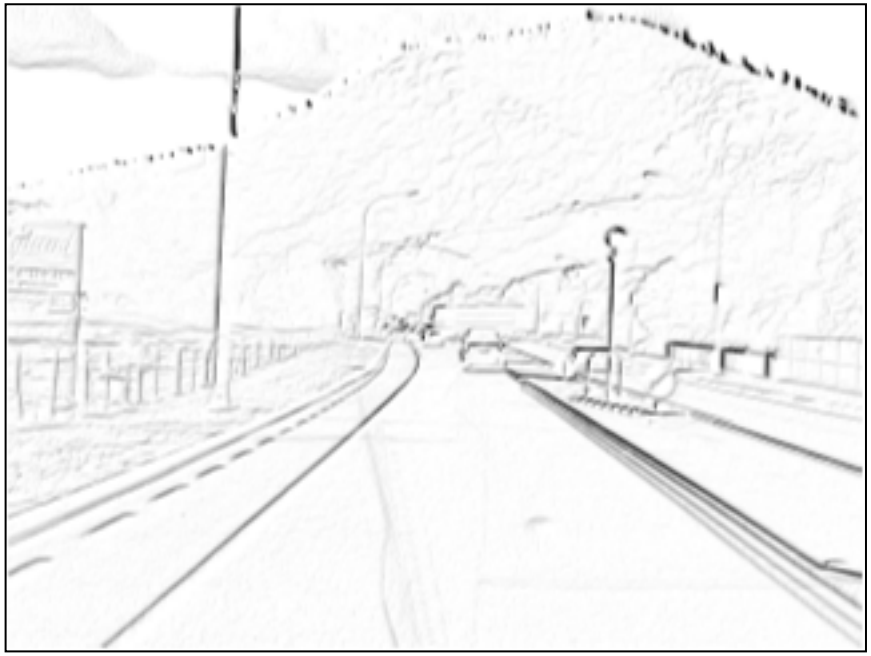
Which data and why, which operation and why, ...
Similarity to previous experiments?
Safety

c. Efficient use of results

Joint data base in the group, multi-use of data, ...

A little example: reduce toner usage when printing, think about the best way of visualisation

of ... - WHAT?-



5. Thesis Writing

a. Start as early as possible

Students receive the Latex template for their thesis right at the start

First **draft** of structure ideally within the first 3-6 months

b. Regular requests to inform about updates of the thesis

Latex sessions: "how to do ..", uniform Latex style in group

Examples of "final" text samples: demo of careful editing by supervisor

Publications may be turned into chapters or sections of thesis (by leading author only, specifying percentage of her/his contribution)

c. The final 10-12 months

Constant pressure for continuous progress (e.g., counting backward, what needs to be done by when to ensure the final deadline)

Something to be decided at the beginning: "I" or "we"

Following common practices, as explicitly formulated by Donald Knuth [41], I use "we" rather than "I" in this thesis for inviting the reader to be part of this "journey". However, I confirm that I, [redacted], was the sole author of this thesis; co-authors of publications [54, 55], where I was the leading author, have confirmed that I may use elements of these two publications as suitable for my MSc thesis.

The thesis is the unique summary of the student's MSc and PhD experience. I consider a "we" as being very reasonable (e.g., meaning the student and the reader).

My advice to PhD students in plain numbers:

100 pages text (normal line spacing of 1.5, not of 2)
written in Latex and well-structured into

Chap 1: Intro, with "structure of thesis"	(8 pages)
Chap 2: State of the art	(20 pages)
[**Chap 3:** My idea ... model ... theory	(20 pages)
Chap 4: My proof that it works	(25 pages)]
Chap 5: Comparison with others	(25 pages)
Chap 6: Conclusions	(2 pages)

+ front pages (no list of tables or list of figures)

+ 60-100 references
(also of own 4-6 conference papers and
1-2 submitted journal papers)

+ subject index

Submit after 3 years in the PhD program

Examples of "structured advice" for writing the thesis.

Motivation: The reader needs to understand why the subject was of importance for doing this study, and why the outcome is worth assigning a PhD degree.

Selection: On the suggested 100 pages there is normally no space to describe everything what was done in the PhD project; a selection of the “largest challenges”, of the “biggest surprises”, of the “most satisfying results” is recommended. Less is often more.

Tell a “story”: The reader should be taken through a story, starting with defining the plot (the “actors”, the “conflicts”, the “ongoing processes”, ...), then the way how it developed, and also include the “negative outcomes” into the conclusions; only showing the “good results” is misleading in general.

Examples for ”academic accuracy” when writing the thesis.

Subject index: Points to the page where a new notion, acronym, symbol, ... appears for the *first time*;
write this notion there in *Italics*, and provide at this place of its first appearance a precise definition of this notion.

Do not use any undefined variation of a notion,
if it is called "yellow submarine", then it is not called a "yellow watercraft" or a "colored submarine"
- academic language needs to be **precise**.

Prepare a plan for using symbols, and follow it carefully.
Use **standards** where possible.
p is a point, f is the focal length, and so forth.

If a caption of a figure ends with a full stop, then captions of ALL figures end with a full stop. ”**Consistency**" is the word.

References follow a uniform layout and are all **complete**: with all authors, title, place where published, page numbers, year.

6. The Oral Exam

There should be only one quality standard for PhD's - worldwide.

The oral exam should be a very special event for the student.

A careful evaluation of the thesis should be performed by a reasonably sized group of experts.