

Computer Graphics and Image Processing Introduction

Part 1 – Lecture 1

COMPSCI 373

■ Lecturers:

Associate Prof. Patrice Delmas (303.391) → Week 1-3, 11-13

□ Contact details:

p.delmas@auckland.ac.nz

Office: 303 - 391 (3rd level CompSci building)

□ Office hours: Wed 3-4pm, also available right after each lecture

Dr. Burkhard Wuensche (810.825) → Week 4-10

■ Tutors:

□ Lindsay Shaw, Trevor Gee

□ Check <https://www.cs.auckland.ac.nz/courses/compsci373s1c/tutorials/>

■ Lecture time:

□ Monday 11-12pm (260-092)

□ Tuesday 3-4pm (301-G050)

Friday 3-4pm (303-G20)

■ Marking:

□ 25% assignments, 20% test, 55% examination

■ Weekly Assignments on Coderunner

□ Weekly assignments from week 3

□ Practise assignment on week 2

■ A large Computer Graphics assignment (TBA)

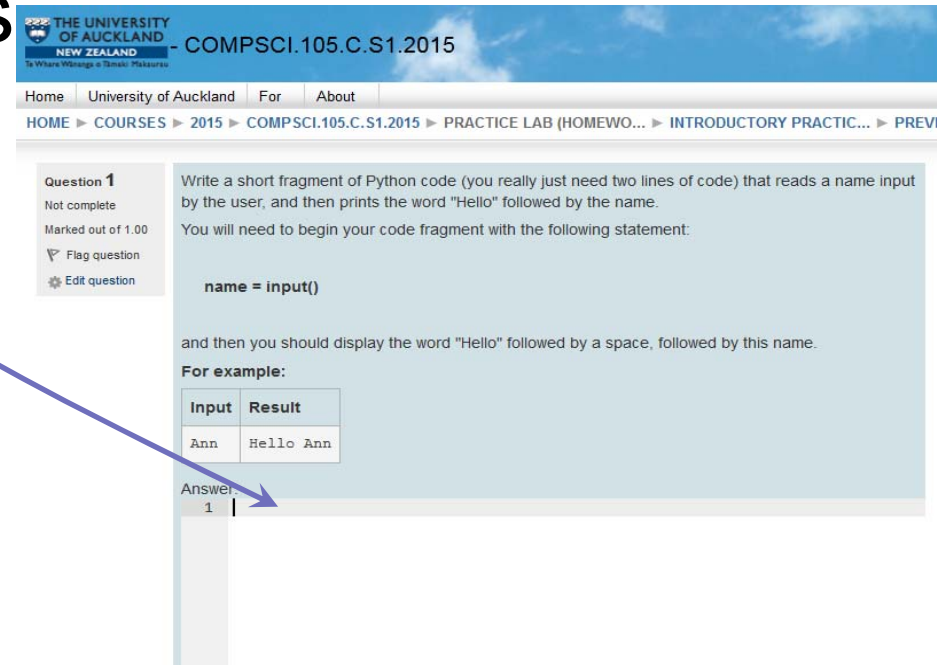
Weekly assignments

All weekly assignments will be using CodeRunner

- <https://www.coderunner.auckland.ac.nz>

Type your solutions directly in the browser

Each assignment contributes towards your final grade



The screenshot shows the CodeRunner interface for a Python assignment at the University of Auckland. The page title is "COMPSCI.105.C.S1.2015". The navigation bar includes links for Home, University of Auckland, For, and About. The breadcrumb trail shows the path: HOME > COURSES > 2015 > COMPSCI.105.C.S1.2015 > PRACTICE LAB (HOMEWO... > INTRODUCTORY PRACTIC... > PREVIOUS.

Question 1
Not complete
Marked out of 1.00
Flag question
Edit question

Write a short fragment of Python code (you really just need two lines of code) that reads a name input by the user, and then prints the word "Hello" followed by the name.
You will need to begin your code fragment with the following statement:

```
name = input()
```

and then you should display the word "Hello" followed by a space, followed by this name.

For example:

Input	Result
Ann	Hello Ann

Answer:
1

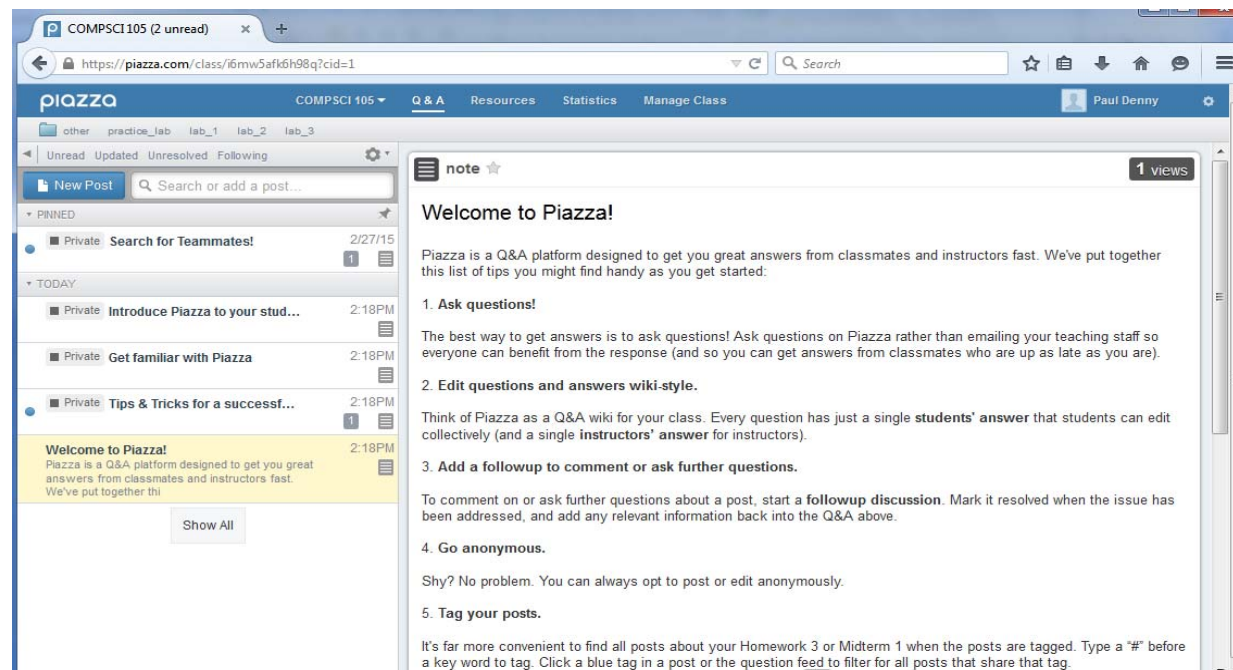
A blue arrow points from the text "Type your solutions directly in the browser" to the answer input field.

Piazza forum

We will be using Piazza as a discussion forum

- You will receive an email with an activation link

Please feel free to answer each other's questions



Class reps

We need to elect class representatives

- You get to attend the very exciting staff/student meetings (free food!)
- Find out a bit more about how the department runs!
- Represent your classmates!





Assessments

- ▶ Note: Students **must** obtain a pass in both the practical (assignments) and non-practical work (test + exam) in order to pass as a whole
 - ▶ Practical: (25%)
 - ▶ Weekly Assignments
 - ▶ A C++ graphics assignment
 - ▶ Theory: (75%)
 - ▶ **All MCQs**
 - ▶ Test: 20%,
 - ▶ Tuesday 3rd May 6.15pm-7.45pm
 - ▶ Exam: 55%
 - ▶ TBA
 - ▶ **Good news:** Mock-up tests and exam available on coderunner before the test and exams
 - ▶ Good for training
 - ▶ Good for confidence
 - ▶ Helps you assess your progress
-



Policy on Cheating and Plagiarism

- ▶ We use many ways to check that the work students submit for marking is their own and was not produced by, or copied from, someone else.
 - ▶ A comparison program to automatically compare all submissions from students.
- ▶ Note:
 - ▶ All assignments deemed to be too similar are automatically allocated a zero mark.
 - ▶ All students who submitted these assignments are entered in the duplicate assignment register (a list of students whose work is known to have been copied). This list is maintained over many years.
 - ▶ Students who have been caught cheating will be notified by email.
 - ▶ Offenders may be referred to the University Disciplinary Committee
- ▶ Both the person who copied the work and the person whose work was copied are allocated a zero mark.
 - ▶ It is important that you do not lend your assignments to others. Never give anyone a copy of your assignment. It is the responsibility of each student to ensure that others do not copy their work.
 - ▶ Read: <http://www.auckland.ac.nz/uaa/home/about/teaching-learning/honesty>



Assessments (con't)

- ▶ Note: Students **must** obtain a pass in both the practical (assignments) and non-practical work (test + exam) in order to pass as a whole
 - ▶ Missed work
 - ▶ If you miss the deadline for an assignment and have a valid reason, you should email the lecturer/course coordinator **ASAP**
 - ▶ If you miss the test/exam for any valid reason, or you sit the test/exam but believe that your performance was impaired for some reason, then you may be able to apply for an aegrotat, compassionate or special pass consideration.
 - ▶ Refer to the online information on Missed Exams, Aegrotats and Compassionate Consideration:
<http://calendar.auckland.ac.nz/regulations/academic/examination.html>
-



Course content

Lecture
dates (NOTE:
content is
subject to
change - see
"Lectures"
web pages):

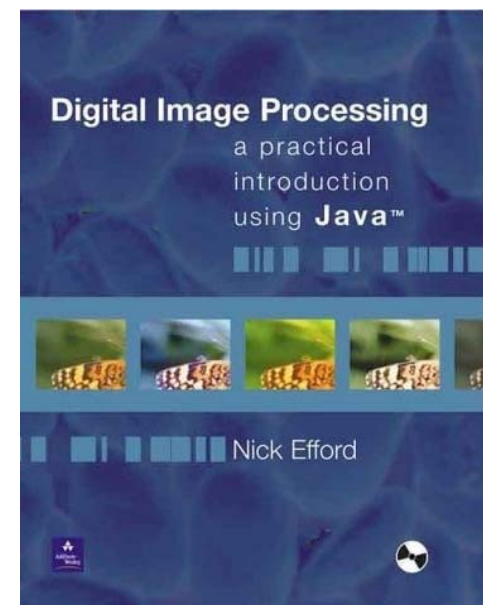
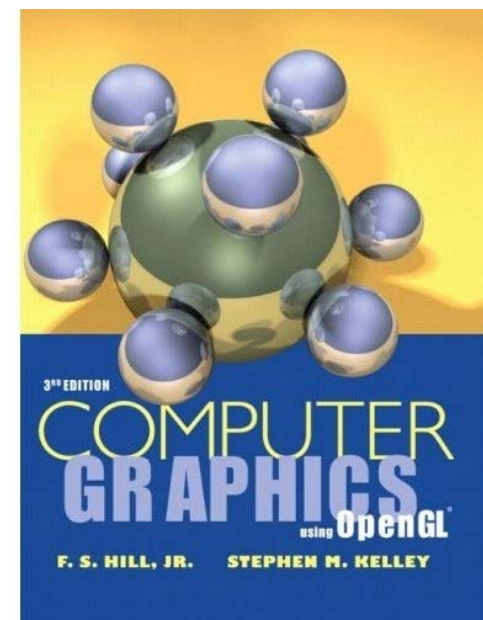
Week 1: Patrice: Introduction, 2D and 3D Geometry
Week 2: Patrice: 2D and 3D Geometry, Colour
Week 3: Patrice: Image Processing Mathematical Tools
Week 4: Burkhard: Introduction to Graphics Research, Introduction to OpenGL
Friday 25 March - Tuesday 29 March EASTER BREAK
Week 5: Burkhard: Introduction to OpenGL
Week 6: Burkhard: Illumination and Shading
Week 7: Burkhard: Introduction to Modelling, Modelling with Polygonal Meshes
Saturday 16 April - Sunday 24 Apr: Mid-semester break
Week 8: Burkhard: Texture mapping
Week 9: Burkhard: Curves and Surfaces
Week 9: Mid-Term test (Tuesday 3rd May 6.15pm-7.45pm): See Tests and exams
Week 10: Burkhard: Ray Tracing
Week 11: Patrice: Basics of Mathematical Morphology
Week 12: Patrice: Image Filtering and Segmentation
Week 13: Patrice: Moving Window Transform

References

- F.S. Hill. Computer Graphics using OpenGL (2nd or 3rd Edition). Prentice Hall.
- Nick Efford. Digital Image Processing: A Practical Introduction Using Java. Addison Wesley.

C/C++:

- C Reference Manual
<http://www.cs.bell-labs.com/who/dmr/cman.ps>
- Bruce Eckel - Thinking in C++
<http://www.ibiblio.org/pub/docs/books/eckel/>
- C++ for Java Programmers
<http://www.jgcampbell.com/cpp4jp/cpp4jp.pdf>
- See also CS373 resources page



A bit more about me

- 10 years lecturing Image processing
- 15 years at UoA (lecturing 105,210,373,375,716,773,775)
- 20 years doing research
- What I dislike: noise during the class, cheating (test, exam, assignments)
- What I like: engaging students, questions from students, ask questions to students (including the ones sleeping, talking, txtng or disrupting the class)
- What I do outside 373 this semester:
 - ☐ I teach 773
 - ☐ I do research in 3D computer vision:
 - www.ivs.auckland.ac.nz/



Email me for

Mistakes in the lecture notes

Dead-links on the webpage

Issues not related to courses (personal problems-valid request for extension)

Forum

Check it as often as you want.

I tend to read the forum (when close to assignment deadlines) and do answer but likely not as fast as the tutors.

The tutors are taking care of the forum.

Facebook

I am happy to post on the course Facebook page

Email

Check email the night before each lecture

- There might be special tutorials
- Other important information

Tutor

Is here to help

Has to help as many students as possible (be minded of others in need)



Miscellaneous

- We will have 3 lectures a week. You need to keep up with the pace:
 - Each new lecture will require you to know and understand the content of the previous lectures.
 - You must do the exercises provides with the lecture notes to make sure you really understand the course content
 - Tutorials are a great way to supplement lectures
 - Learn as much as you can on your own, lectures and tutorials are a start not the end of the journey
 - Outside office hours and tutorials, tutors are not supposed to be at hand

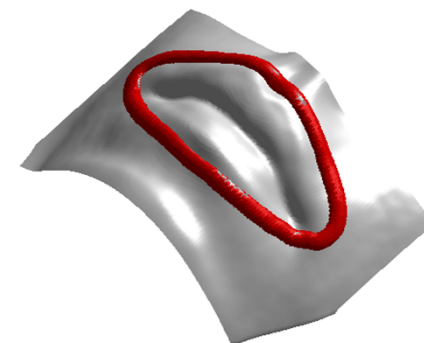
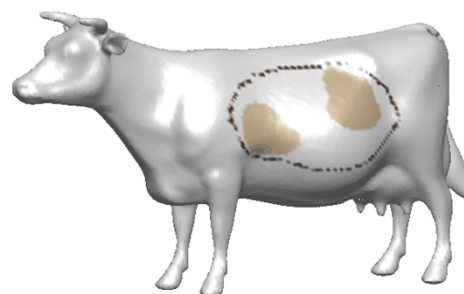
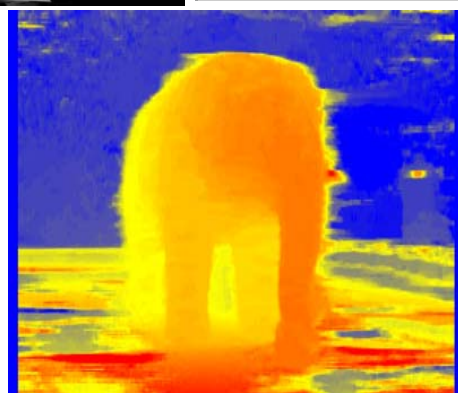
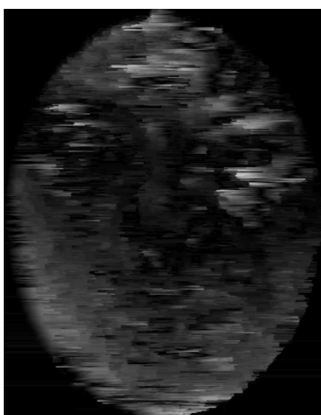


How to progress while Learning

1. Read the lecture notes after each lecture
 - a. Make a summary of what has been seen on the lectures
 - b. Redo examples already treated (during the lectures) or/and do the untreated examples
 - c. Do examples without refereeing to the lectures
2. Read the materials provided online
 - a. To learn more
 - b. To complement lectures
3. If you have questions or do not understand something
 - a. Do 1
 - b. Do 2
 - c. **Attend class/tutorials**
 - d. Check the forum
 - e. Ask other 373 students
 - f. Ask a tutor during office hours
 - g. Email me (only if points a to f are completed and did not bring relevant information)
4. How to prepare test/exam
 - a. Do previous years tests/exams
 - b. Do exercises of the course/tutorials/exercise course book
 - c. Do-redo the coderunner tutorials and mock-up test/exams
 - d. Do 1 and 2
 - e. Start again from a.



A glimpse of the research at the Intelligent Vision Systems Lab, Department of computer Science, The University of Auckland



Low cost + advanced theory = improved performance

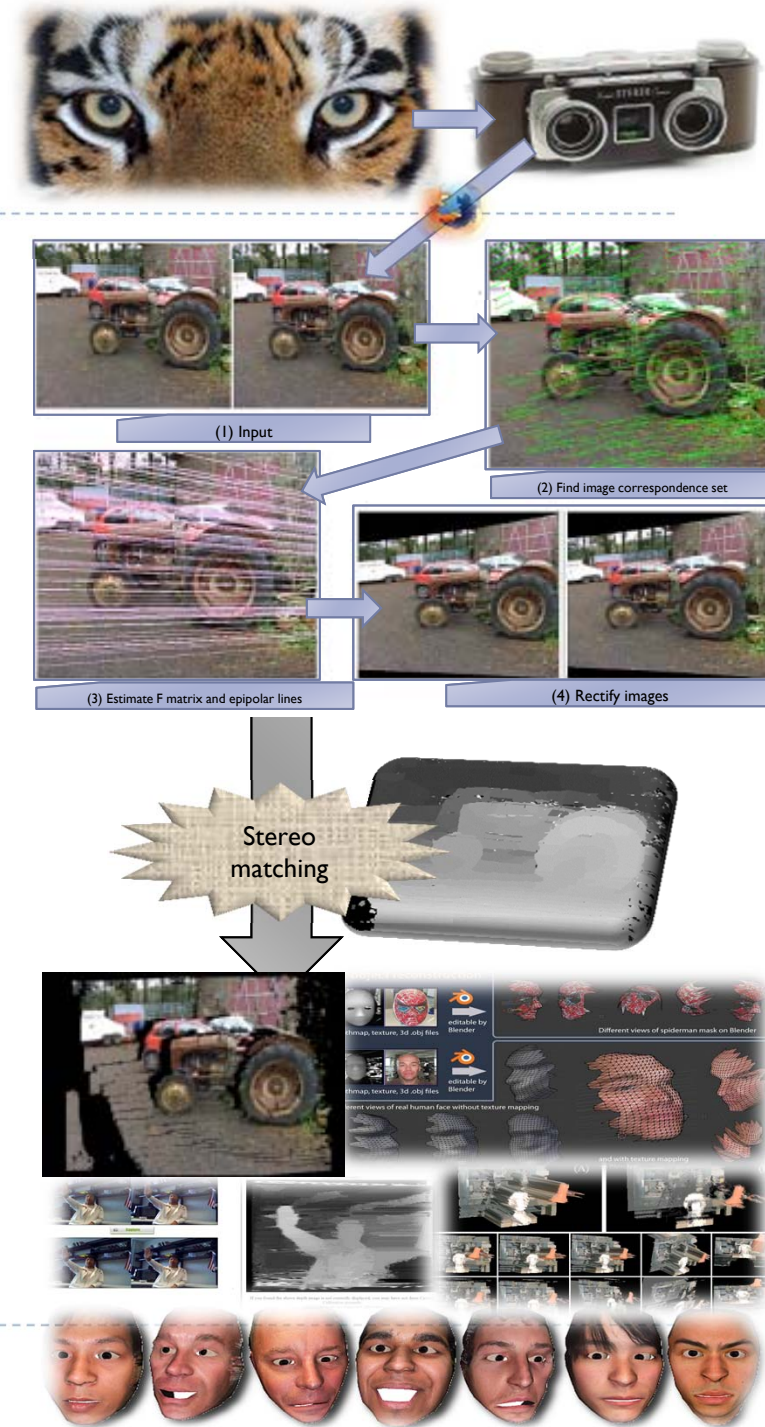
Online Interactive Web-based Stereo Vision

► Build a portable /comprehensive website and mobile app:

- Accept off-the-lab real-life photos of different types:
 - Left + right
 - Anaglyph
 - Auto-stereogram
- Automatically align images to epipolar stereo form
- Reconstruct 3D information and display online
- Returns **different 3D** results

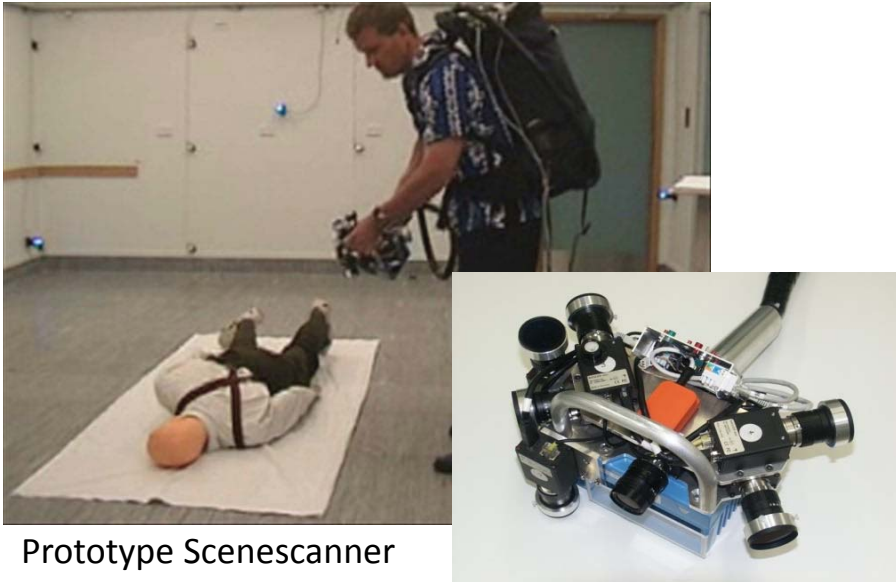
► [URL: www.ivs.auckland.ac.nz/quick_stereo](http://www.ivs.auckland.ac.nz/quick_stereo)

- Thousands of visitors from **47 countries** around the World
- **First rank** on **Google Search** on key words:
 - *online stereo matching*
 - *online stereo vision*



Range & Video Data Fusion

- ▶ Improving 3D models by combining video (multi-view) data and laser range data
 - ▶ Reliability
 - ▶ Resolution
 - ▶ Accuracy
 - ▶ Completeness



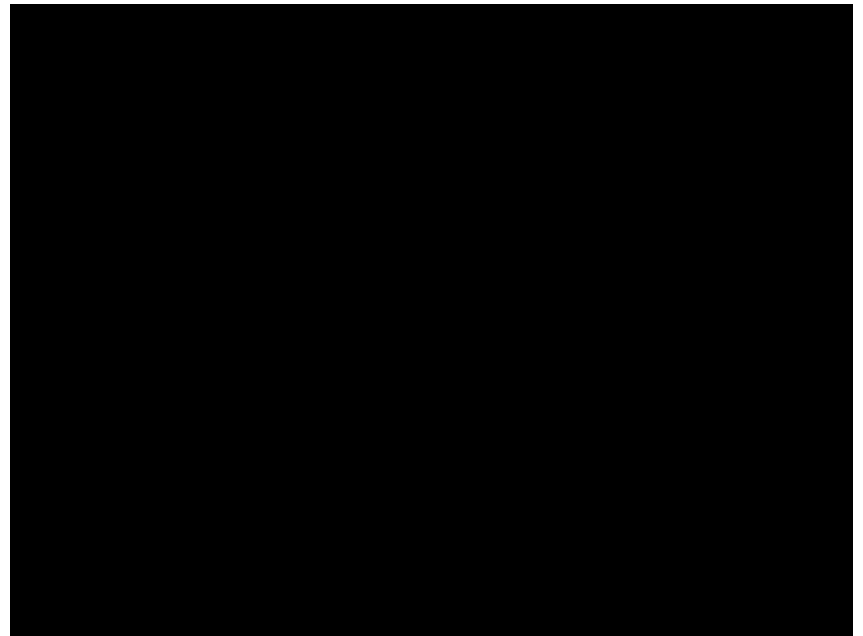
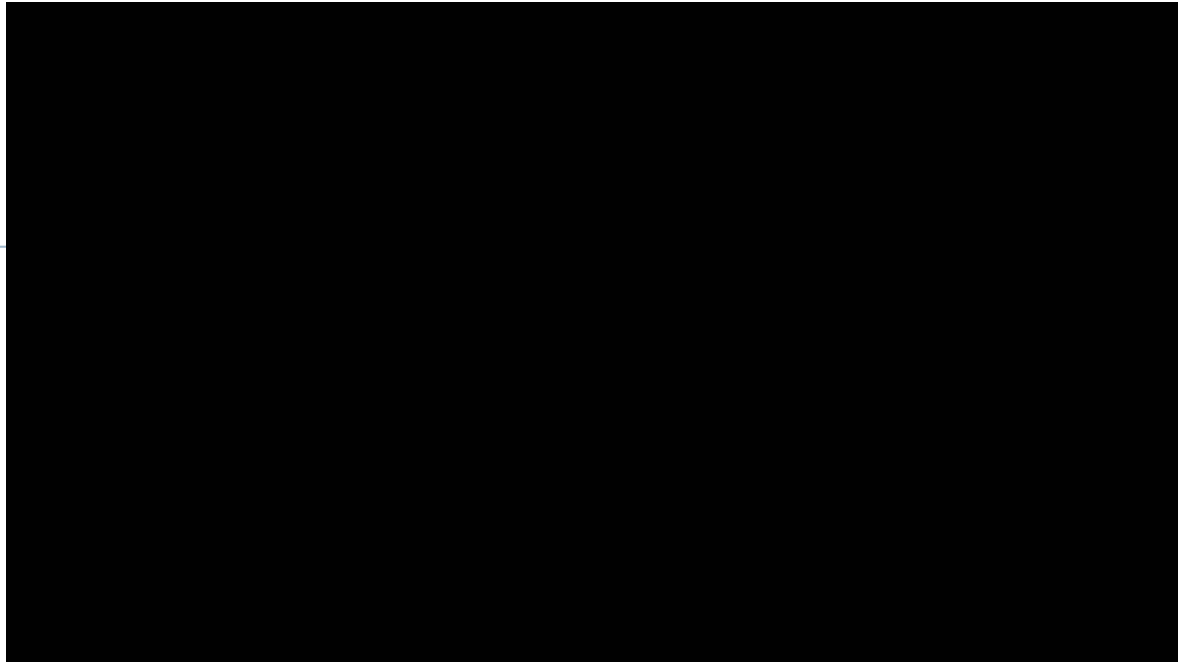
Prototype Scenscanner



Kinect Live Reconstruction



Videos



The development of a stereo- photogrammetric setup

S.Bertin, H.Friedrich, P. Delmas, Y.H. Chan, Trevor Gee

OBJECTIVES (CS only):

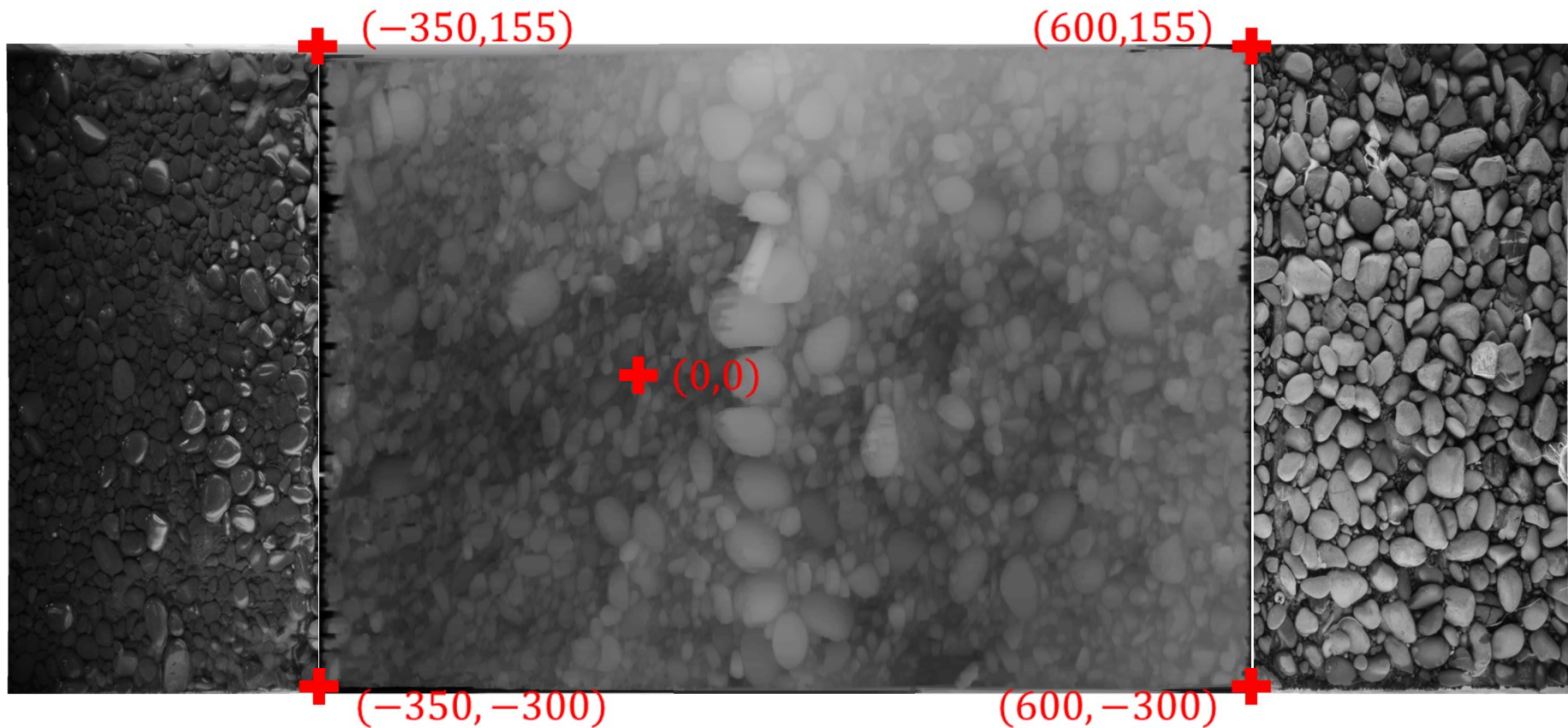
- ❑ *A high-resolution, non-proprietary, stereo-photogrammetric setup for microtopography measurement in a laboratory flume, and means to evaluate its accuracy.*
 - Differ from previous photogrammetric applications in Hydraulics
- ❑ *Basis for 2-media and underwater photogrammetry.*

- From the depth map and the calibration results, a **point cloud** containing the 3D World Coordinates of each pixel is extracted.

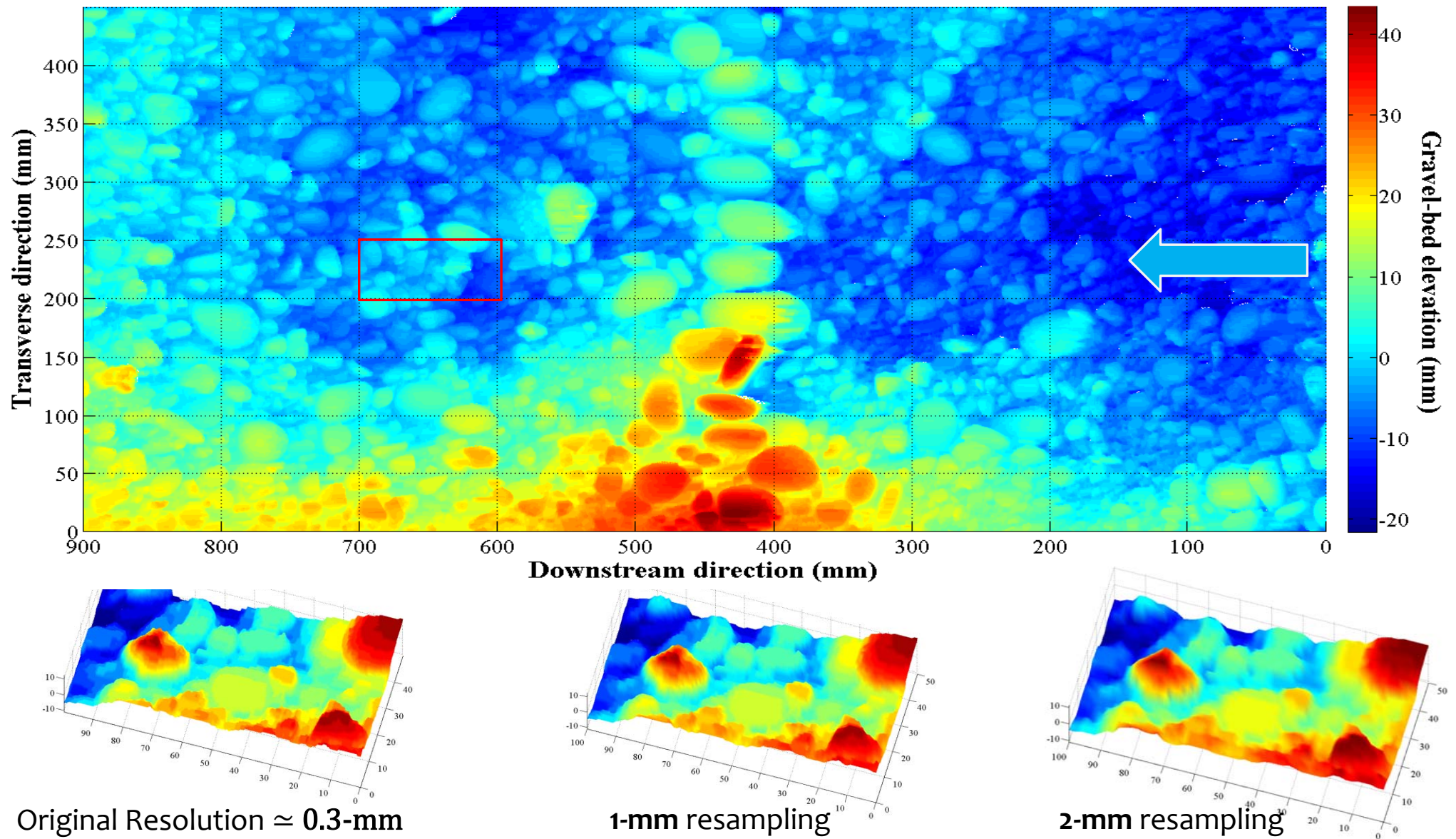
Depth map → 2D coordinates of corresponding pixels in the L and R images.

Calibration results → 3D intersection of the 2 lines between the cameras' centre and the corresponding pixels

- 210MB text file containing the X,Y,Z coordinates (in mm) of all measured points
- The left image is the basis for the coordinates



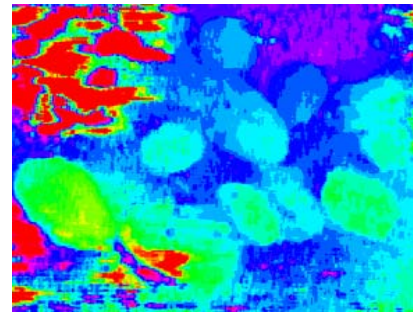
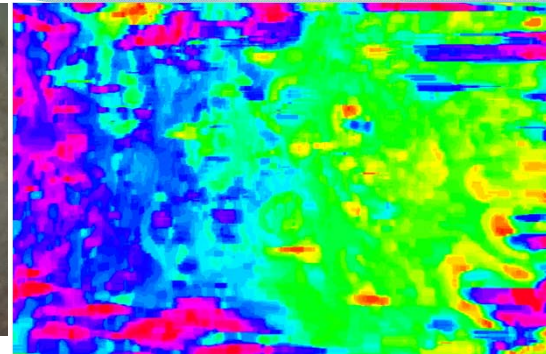
- The point cloud is opened with MATLAB®, and a **3D DEM** is plotted onto adjustable orthogonal grids...



In Situ: The Ngongotaha river experiment - 2



In Situ: The Ngongotaha river experiment - 3



2016 Field trip

At Marine Sciences Institute

First week after the end of class (early June)

We may invite 2-3 373 students with interest in post-graduate studies

Interested in Post-graduate studies Research projects

**Talk to Patrice, and Trevor to know more about
what is going in at the IVSLab**

**Talk to Burkhard to know more about what is going
on at the Graphics Group**