



Università degli Studi di Verona

Scuola di Dottorato di Scienze Ingegneria e Medicina

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Dottorato di ricerca in Informatica

Graduate course in

Image Registration – 2D, 3D, Rigid and Deformable Scenes

April 28 - May 2 and May 12-16, 2008 (20 hours)

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Description

Image registration is the problem of relating images of the same scene or object where the latter deforms between the different images. The course covers the established and rising paradigms and computational methods issued from the field of Computer Vision. In more details, the course touches the modeling problem (specific, e.g. face, versus generic, e.g. smooth, models and priors), the definition of error criteria (how to measure the similarity of images, which image cues can be used) and computational methods. The well-posedness of the problem for threedimensional reconstruction from a monocular image sequence is examined.

Some direct applications of these techniques included in the course are:

- Surface augmentation – How to replace or modify the appearance of some deforming surface in a sequence of images.
- Flexible scanning – How to recover the flat appearance of a paper sheet from images, for instance images of a book.
- Deformation capture and video stabilization – How to split a video stream motion field into camera displacement and surface deformation to either stabilize the video or apply the deformation to a synthetic surface.
- Medical image registration – How to register images issued of different types of sensors and merge the cues specific to each modality.

The students are expected to have a mature and operational mathematical knowledge. Linear algebra and basic geometry are mandatory disciplines. Knowledge within statistics, scientific computing and numerical optimization are an advantage.

The course is organized in two weeks of intensive lecturing (20 lectures over calendar weeks 18 and 20) and two exercise periods (calendar weeks 19 and 21-23). A report on the exercise should be written in English. This may be done in groups of up to three students. The reports are evaluated internally after the course and a decision of success made. The deadline for the report is June 19.

Week 1 – April 28 - May 2, 2008: General Points and Rigid Image Registration

28/04 (14.00-16.00) - Introduction (2 hrs)

- 1.1 Sensors.
- 1.2 Cost function and image cues.

29/04 (10.00-12.30) - Numerical optimization (2 hrs)

- 2.1 Linear Least Squares (LLS) .
- 2.2 Nonlinear Least Squares (NLS).

29/04 (14.00-16.00) - 2D configurations (2 hrs)

- 3.1 Feature-based homography estimation .
- 3.2 Pixel-based homography estimation.

30/04 (10.00-12.00) - 3D configurations (2 hrs)

- 4.1 Overview and camera reconstruction.
- 4.2 Stereopsis.

30/04 (10.00-12.00) - Generalized Thin-Plate Spline warps (2 hrs)

- 5.1 Rigidity.

Week 2 – May 12/16, 2008: Deformable Image Registration

12/05 (14.00-16.00) - Introduction (2 hrs)

- 4.1 Free form registration.

13/05 (10.00-12.00) - Parameterized warps (2 hrs)

- 5.1 Radial basis function (RBF).
- 5.2 Handling occlusions.

13/05 (14.00-16.00) – Morphable models (2 hrs)

- 6.1 General morphable models.
- 6.2 Low-Rank 3D vision.

14/05 (10.00-12.00) – 3D paper modelling (2 hrs)

- 7.1 Tracking-by-detection.
- 7.2 Paper: image registration and 3D reconstruction.

14/05 (14.00-16.00) – Range sensors (2 hrs)

- 8.1 2.5D templateless registration.
- 8.2 Closure.

Lectures will take place at the

Sala Verde

Dipartimento di Informatica

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The course is supported by the Università degli Studi di Verona, with a CooperInt grant.

The admission to the course is FREE. Attendees must submit an application via email to the local organizer indicating their affiliation and current position by **April 25, 2008**.

Proficiency certificates or equivalent credits will be provided on request and upon completion of independent homework (as described in the course homepage).

Local organization and contact:

Umberto Castellani

umberto.castellani@univr.it

Web info and course materials:

<http://www.lasmea.univbpclermont.fr/Personnel/Adrien.Bartoli/Classes/VIPS-IR/index.html>