43075-01 Probabilistic Shape Modelling

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Exercise 3 — Non-rigid registration

Introduction	23.04.
Deadline	**30.04, 14.00**

Parametric registration in Scalismo

On `https://unibas-gravis.github.io/scalismo-tutorial/tutorials/tutorial12.html` you can find a tutorial on parametric, non-rigid registration.[1] Your task is to go through the tutorial, experiment with the code, and to answer the questions below.

Please write down short answers to the questions (max 2-3 sentences per question) and upload a pdf or text file with your answers onto courses before 30.04, 14.00.

Question 1: Draw samples from the Gaussian process model, which is used for the registration. What do you think about the model? How would you improve it?

Question 2: Assume that in addition to the reference and the target surface, you would be given corresponding landmark points. How would you incorporate them into the registration algorithm? How would this change the registration code?

Question 3: What is the influence of the regularization parameter? What happens when you set it to a large value (e.g. $\gg 1$). What if you set it very small?

Question 4: Could you give a probabilistic interpretation to the regularization parameter? *Hint: Look at the derivation of the variational formulation in the lecture slides.*

Question 5: When we set the regularization parameter to a very large value, we see that the coefficients corresponding to the leading principal components are all adjusted, whereas the trailing components remain small (close to zero). Can you explain this?

Question 6: A regularization value of 0 means, that we don't penalize any solutions in our space. Why is our approximation still not perfect?

Question 7: After performing the registration, we could project the MAP solution we found using our model onto the target surface. This projection result in a perfect approximation of the target surface. Should we always do this or can you think of a situation where this is not appropriate?

We will discuss these questions in the plenum on the 30.04.

[1] Those still using ScalismoLab can access the tutorial by typing (in the code pane):
`goto("http://shapemodelling.cs.unibas.ch/exercises/Exercise14.html")`