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- [Forum](#)
- [Chat](#)
- [Videos](#)
- [Evaluations](#)

- [Home page](#)
- [Start of studies 2020](#)
- [exams](#)
- [Education](#)
- [Your FSI](#)
- [University policy](#)
- [Contact](#)

Examination protocol IMIP, September 2015

ECTS: 7.5

Examiner: Prof. Dr. Andreas Maier

Standard entry from Cloud, Structure Tensor and Vesselness incl. Blobness and Structure in 2D and the resulting product of exp functions. Don't forget the maximum about the sigmas for the scale space.

After that he wanted to hear about consistency. I first started with the epipolar geometry (picture) and explained it, when I asked if I should go into more detail about the Essential Matrix, he didn't want to hear anything more about it but really Consistency. So the Radon transformation of Epipolar Planes is constant in Parallel Projection, not with Fan Beam, hence Grangeat's Theorem. It is important here that the plane integral is derived along the plane normal and then approximated with the normal on the epipolar line in the image plane. He actually wanted to continue, but I just started with the position of the epipoles in the circular trajectory, so I was also allowed to explain in which direction of movement one can or not in which position of the epipoles.

Then it went on with EKG gating, the sketch with the projection angle on the x- and heart phase on the y-axis, said that you take the projections from the quiet heart phases. He didn't want to hear image-based, but then directly how to get a 4D reconstruction. He wanted to hear that an (initial) reconstruction is made for each heart phase. Then somehow I came up with the algorithm that includes neighboring heart phases with the cosine window. After a while I also checked that the algorithm not only works for 3D reconstructions, but is primarily intended for 4D ... Then things went much better again 😃.

So you get an initial reconstruction for * every * heart phase, but you want to improve it. So you make a motion estimation and a compensation by using and iterating the motion fields for a more precise reconstruction.

How exactly does the estimation work now? With the non-linear registration. But he didn't want to hear anything more about that.

Instead he asked how 4D Reconstruction can be made "easier" / faster (or something like that). Maybe he said something like that, at least it was immediately clear to me that he wanted to hear the Adaptive Temporal Gaussian Filter. So I painted the plot with the projections through the point and the attenuations, plus an epipolar geometry picture, so that one understands what it represents. Then the FT from the plot is drawn with a peak at the heart rate, which of course is only (strong) with the voxels that are actually in the heart. This is then used to interpolate the sigma (no exact formulas). You filter the individual voxels using the time axis, which was also important. (Now when writing the protocol, I also see the advantage of this - you don't have to make iterative reconstructions:

In principle, it was mainly that he gave a topic and then I could just tell until I was finished or he asked about the next one. The only real exception was image-based gating. I mainly used formulas up to Vesselness, after which I can't remember any more. For this I sketched many plots and painted little projection pictures. I'm not quite sure whether he wanted to hear the algorithm with the Cosine Window on his own or whether he wanted to get into Adaptive Temporal Gaussian Smoothing from the start.

The mood was good, although as far as I know there had been exams all day 😊

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