MIPDA EXAM SS 19

1) a) name and explain 2 types of image distortion
b)

$$x = X(x', y') = \sum_{i=0}^{d} \sum_{j=0}^{d-i} u_{i,j} b_j(y') b_i(x')$$

$$y = Y(x', y') = \sum_{i=0}^{d} \sum_{j=0}^{d-i} v_{i,j} b_j(y') b_i(x')$$

Write out the formula for $x_0 = (x_k, y_k)$
c) 3 points (x_k, y_k) given, set up Measurement Matrix M
d) set up linear equation that has to be solved
(solution is something like x = u*M)

e) can M be solved if it has full rank? If yes, is the solution is unique? What does full rank mean?

f) Describe 2 solutions, how M could be solved uniquely.

2) a) Name 3 reasons for IIH
b)

$$\begin{aligned} \mathrm{KL}(p, q) &= \sum_{i=1}^{n} p(x) \log \frac{p(x)}{q(x)} \\ &= \underbrace{\sum_{i=1}^{n} p(x) \log p(x)}_{H(p) = -\sum_{i=1}^{n} p(x) \log p(x)} - \underbrace{\sum_{i=1}^{n} p(x) \log q(x)}_{H(p,q) = -\sum_{i=1}^{n} p(x) \log q(x)} \\ &= H(p, q) - H(p), \end{aligned}$$

What is H(p,q) and What is H(p)? Name a property of the Kullback Leibler Divergence.
c)

$$h(s) = \int_{-B}^{B} |\omega| e^{2\pi i \omega s} \mathrm{d}\omega = \int_{-\infty}^{\infty} |\omega| \operatorname{rect}\left(\frac{\omega}{2B}\right) e^{2\pi i \omega s} \mathrm{d}\omega,$$

How is this filter called?
d) set up the discrete version of this filter
e) how is the discrete version of the filter called?

3) IIH Correction with polynomial surface

a) 3 points (x,y) given, set up measurement matrix to solve for x= M *$(m,t)^T$
(linear equation)

b) how can this linear system of equations be solved as a least squares problem?

4) sinogram is given

a) how is the picture called?

b) describe the position and shape of the objects in the sinogram (circles and boxes)

c) Describe Tuy's condition and draw one unit sphere for which the condition holds and one sphere for which it does not hold

4)

a) what is the main disadvantage of ART?

b) explain 2 ways how this problem in ART can be solved

5) given:

$$\boldsymbol{p}_k = \boldsymbol{R}\boldsymbol{q}_k + \boldsymbol{t}.$$

a) what is R and t and what is their influence on q_k?
b) this is a non-linear problem to optimize for rotation-angle and translation-vector. Describe a way, how this could be solved linearly (I think e.g. point-to-point error matrix with SVD/ Quaternions was meant hereby)

I don't remember all the questions anymore, but in total the exam had 60 points and each task had between 2 to 6 points.