Technion – Israel Institute of Technology



HW1

**Vision Aided Navigation**

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# Basic Probability and Bayesian Inference

## Question 1 : Consider a random vector with a Gaussian distribution, written in covariance form Show the corresponding information form is:

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## Question 2 : Consider a standard observation model involving a random variable . and assume the initial belief regarding the state is a Gaussian with mean and covariance .

### Write an expression for the prior and the measurement likelihood .

### A measurement is acquired. Assuming the measurement was generated by the measurement model (1), write an expression for the posterior probability in terms of and the measurement likelihood .

### Derive expressions for the a posteriori mean and covariance such that

### A second measurement, , is obtained. Assuming from last clause is given, derive expressions for .

## Question 3 : Consider a multivariate random variable . with the following state transition mode and a standard observation model as in exercise 2.

### Write an expression for the motion mode

### Assume the robot executes action and then acquires a measurement . Write an expression for the a posteriori pdf in terms of the prior, motion and observation models.

### In the same setting, consider the a posteriori pdf over the joint state Show that calculating the maximum a posteriori (MAP) estimate for is equivalent to solving a non-linear least squares problem.

### Assume the a posteriori pdf over the joint state is given in covariance and information forms as Indicate the dimensionality of the covariance matrix and of its components. We are interested in the marginal pdf over the state , while marginalizing out the past state . Write expressions for the marginal covariance and information matrices, and , over the state such that: