

# ARKIV FÖR MATEMATIK Band 2 nr 8

---

Communicated 10 October 1951 by HARALD CRAMÉR and HANNES ALFVÉN

---

## Some statistical problems in the theory of servomechanisms

By MAURITZ SUNDSTRÖM

With 12 figures in the text

---

### Contents

	Page
I. Introduction .....	140
I. A few notes on errors.....	142
a) Various errors .....	142
b) Reduction of errors by smoothing.....	142
c) Correlation between smoothed values .....	146
d) Errors of derivatives .....	146
e) Errors of integrals.....	147
II. Experimental determination of transfer functions .....	148
a) General reasoning .....	148
b) Numerical examples .....	154
III. Determination of inverse Laplace transforms .....	159
a) General reasoning .....	159
b) Numerical examples .....	165
IV. The effect on the output of omitting input frequencies in linear systems	167
a) Arbitrary input .....	167
b) Step input replaced by a Fourier series .....	169
c) Numerical example .....	172
V. Some fundamental investigations of the probability distributions of the input and the output .....	174
a) General considerations .....	174
b) Linear systems with constant coefficients .....	179
c) Approximate treatment of general systems .....	183
d) Chain processes .....	185
e) Continuous determination of the variance of the output.....	187
f) A method of computing the probability distribution of a Laplace transform from the distribution of a time function and vice versa	188
g) Variation of parameters in a servo circuit .....	191
h) Representation in Hilbert spaces .....	193
i) More than one input function.....	195
VI. Noise in linear systems .....	196
a) Non-stationary discrete processes. Two noise components .....	196
b) Stationary processes as a special case .....	203
c) Continuous reasoning. An arbitrary number of noise components	204
d) Discussion of the solutions. Short summary of results .....	211
e) Some considerations about linear integral equations of the first kind	212
f) Some examples of linear noise problems .....	218