



## Error Control Coding

**Antal poäng:** 5.0. **Valfri för:** D4, E4. **Kursansvarig:** Mats Cedervall. **Förkunskapskrav:**

Digitalteknik **Rekommenderade förkunskaper:** Informationsteori

**Prestationsbedömning:** Godkänt projekt är ett krav för att få tentera. Tentamen (5 tim)

är skriftlig och av problemlösningstyp. **Övrigt:** 2 frivilliga laborationer **Webbsida**

<http://www.it.lth.se/ecc>

### Innehåll

Error control coding should protect digital data against errors which occur during transmission over a noisy communication channel or during storage in an unreliable memory. The last decade has been characterized by not only an exceptional increase in data transmission and storage but also in a rapid development in microelectronics providing us with both a need for and the possibility to implement sophisticated algorithms for error control.

**Introduction.** Why error control? Block codes - a primer, a first encounter with convolutional codes, block codes vs. convolutional codes.

**Convolutional encoders - structural properties.** Convolutional codes and their encoders, the Smith form of polynomial encoding matrices, equivalent and basic encoding matrices, minimal - basic and minimal encoding matrices, minimal encoders, syndrome formers and dual encoders, systematic encoders.

**Distance properties of convolutional codes.** Distance measures, distances for cascaded convolutional codes, upper and lower bounds on the free distance, lower bound on the distance profile, path enumeration.

**Viterbi decoding.** The Viterbi algorithm, error probability bounds for convolutional codes, quantization of channel outputs.

**List decoding.** Decoding with limited resources, list decoding (algorithm, error probability bounds).

**Sequential decoding.** The Fano metric, the Stack algorithm, computational analysis, the Fano algorithm.

**Convolutional encoders with good distance properties.** Computing distance spectrum

(FAST), some classes of rate  $R = 1/2$  encoders.

**Block codes.** Reed-Solomon (RS) codes, cyclic codes, discrete Fourier transforms, decoding RS codes (the Berlekamp-Massey algorithm), erasures and errors decoding.

**Trellis coded modulation.** Band-limited channels and QAM, coding fundamentals, lattice-type trellis codes, geometrically uniform trellis codes, decoding of modulation codes, precoding.

#### **Litteratur**

Johannesson, R. & Zigangirov, K. Sh.: Fundamentals of Convolutional Coding, IEEE Press, 1999.

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