

# EE 684 Selected Topics: DSP for emerging applications in compression and telecommunications"

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## **TENTATIVE OUTLINE**

- 1. Shannon's model for communication & information processing concepts
- 2. Goals Properties of data compression (source coding/channel coding).
- 3. Lossless coders including Huffman, run-length, and Lempel-Ziv.
- 4. Scalar lossy techniques with examples.
- 5. Vector quantization systems
- 6. Transform Coding applications
- 7. JPEG and JPEG2000 Picture Coding
- 8. Video Coding: H.261-to-MPEG4 and Video Standards and Systems
- 9. Speech Production, LPC and other Speech Coding Systems
- 10. Hands-on Applications in the form of team projects possibly on:
  - Speech Compression
  - Classical still image compression including DPCM, DM, transform coders and JPEG.
  - Image blurring and de-blurring
  - Separation of objects in imagery
  - Video Codecs using H.261, JPEG, MPEG compression
  - Applications to noise and echo cancellation
  - Applications to CDMA and Wi-Fi systems
  - Digital TV systems
  - Digital cinema systems.
- 11. Special Topics to bee assigned to graduate students enrolling EE684.

#### **RECOMMENDED BOOKS**

- H. Abut, *Vector Quantization*, IEEE Press, 1990
- H. Abut, J.H. Hansen, and K. Takeda, Advances for In-Vehicle and Mobile Systems Challenges for International Standards, Springer Science, 2007 ISBN: 0-387-33503-X (Available in early 2007)
- H. Abut, J.H.L. Hansen, and K. Takeda, *DSP for In-Vehicle and Mobile Systems*, Springer Science, 2005. ISBN: 0-387-22978-7. (Collected papers on Vector Quantization through 1990.)
- V. Bhaskaran and K. Konstantinides, *Image and Video Compression Standards: Algorithms and Architectures*, Kluwer-Academic Publishers, 1995. (Good coverage on video standards.)
- T.C. Bell, J.G. Cleary, and I.H. Witten, *Text Compression*, Prentice-Hall, 1990. (Reference book on lossless compression algorithms.)
- T. Berger, *Rate-Distortion Theory*, Prentice-Hall, 1971 (Classical book on rate-distortion theory.)
- T.M. Cover and J.A. Thomas, *Elements of Information Theory*, Wiley, 1991. (Text on Information Theory including noiseless coding.)
- Y. Fischer, Ed., Fractal Image Compression: Theory and Application, Springer-Verlag, NY, 1991.
- A. Gersho and R.M. Gray, Vector *Quantization and Signal Compression*, Kluwer Academic Publishers, 1992. (Solid coverage on fundamentals and applications of VQ.)
- R.C. Gonzalez, R.E. Woods, and S.L. Eddins, *Digital Image Processing Using Matlab*, Prentice-Hall, 2004, ISBN: 0-13-008519-7
- A. K. Jain, *Fundamentals of Digital Image Processing*, Prentice-Hall, 1989. (Basic principles of early image processing techniques.)
- N.S. Jayant and P. Noll, *Digital Coding of Waveforms*, Prentice-Hall, 1984. (Good coverage on scalar quantization and compression.)
- A. M. Kondoz, *Digital Speech: Coding for Low Bit Rate Communications Systems*, Wiley 1994. (Very good book on low rate speech coding techniques.)
- J. Lim, *Two-Dimensional Signal and Image Processing*, Prentice-Hall, 1990. (Good coverage on older image processing techniques.)
- S. J. Mitra, *Digital Signal Processing: A Computer-Based Approach, Third Edition,* McGraw-Hill, ISBN: 0-07-304837-2.
- K.N. Ngan, C.W. Yap, and K.T. Tan, *Video Coding for Wireless Communication Systems*, Marcel Dekker, Inc., New York, Basel, ISBN: 0-8247-04489-4.
- W.B. Pennebaker and J.L. Mitchell, *JPEG: Still Image Data Compression Standard*, Van Nostrand Reinhold, 1993.
- H.V.Poor and G. W. Wornell, *Wireless Communications: Signal Processing Perspective*, Prentice-Hall, 1998.
- B. Porat, *A Course in Digital Signal Processing*, Wiley, 1997. (Very good elementary text on signal processing techniques.)
- J.G. Proakis, M. Salehi and G. Bauch, *Contemporary Communication Systems*, Thompson Brooks/Cole, Belmont, CA, ISBN: 0-534-40617-3.

- K. Sayood, *Introduction to Data Compression*, Morgan-Kaufman, 1996. (Fundamental text on data compression based on Shannon Theory.)
- S.D. Stearns and R.A. David, *Signal Processing Algorithms in Matlab*, Prentice-Hall, 1996. (Excellent Matlab tools for DSP.)
- R. Steinmetz and K. Nahrstedt, *Multimedia: Computing, Communications and Applications*, Prentice-Hall, 1995.
- J.A. Storer, Data Compression Methods and Theory, Computer Science Press, 1988.
- A. M. Tekalp, *Digital Video Processing*, Prentice-Hall, 1995. (Good reference book on image/video processing.)
- K.S. Thyagarajan, *Digital Image Processing with Application to Digital Cinema*, Elsevier Focal Press, 2005. ISBN: 0-240-80729-4 (Latest book on digital image coding including digital cinema.)
- J.W. Woods, *Subband Image Coding*, Kluwer Academic Publishers, 1991. (Very good coverage on subband coding principles & applications.)

#### ACKNOWLEDGEMENT

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- 1. EE372 Lecture Notes by Professor Robert M. Gray, Stanford University.
- 2. Lecture Notes by Professor A. Murat Tekalp, Koc University, Istanbul, Turkey
- 3. TE480 and EE557 Lecture Notes by Professor Hüseyin Abut, Sabanci University, Istanbul, Turkey.
- 4. EE657 Lecture Notes and Student Projects by Professors Hüseyin Abut and K.S. Thyagarajan, San Diego State University.
- 5. Earlier versions of EE658 Lecture Notes by Professor Hüseyin Abut and former Student Projects, San Diego State University.
- 6. A. M. Tekalp, *Digital Video Processing*, Prentice-Hall, 1995.
- 7. **VCDemo** used in image compression examples has been provided by Professor Reginald (Inald) Lagendijk of Delft University of Technology, The Netherlands.