Course Syllabus

Course Title: Algorithms for Digital Signal Processing

Course Code: EE 7740

Credits: Three (3) credits

Duration: One academic quarter.

Schedule: Forty-five credit hours per course.

Prerequisites: EE 6010: Mathematical Methods for Signal Processing

Course Description

This course provides an introduction to the field of advanced digital signal processing algorithms, in particular to Fast Algorithms for Discrete Fourier Transforms, Discrete Linear and Cyclic Convolutions. Transforms such as the Discrete Cosine Transform, the Hartley Transform, the Walsh-Haddamard Transform and others are also reviewed. The course does extensive use of MATLAB and other mainstream software packages for computer implementation and as an aid to understand the structure of the different algorithms. The course requires a research project, research report or paper reviews.

Justification

Even though DSP processors are becoming faster and faster the search for fast algorithms that can process huge amount of data in real time, or as fast as possible, is still an important research subject. This is true not only for the obvious applications related to national defense, but also in applications related to geophysics, medical and earth sciences. The course, in addition, provides an opportunity for the student to tackle very interesting research subjects regarding this field, such as automatic derivation and implementation of signal processing algorithms.

Objectives

To provide an adequate introduction, through the study of selected DSP algorithms, to the field of algorithms for Discrete Fourier Transform and Convolution.
Textbook

by Richard E. Blahut
1st Edition
Addison Wesley
ISBN: 978-0201101553

**Topics Covered**

3. Direct Calculation for the DFT.
4. The Goertzel Algorithm for the DFT.
5. Decimation in Time FFT algorithm
6. Decimation in Frequency FFT algorithm.
7. The Prime Factor Algorithm (PFA).
8. Fast Convolution using the FFT.
9. Cook-Toom Algorithm.
10. Description of other Transforms.
11. Advanced Topic 1: The Tensor Product:
12. Tensor Product and Stride Permutations.
14. Good Thomas PFA.
15. Agarwal-Cooley Convolution Algorithm.
17. The SPL Language and Programming Environment.

**Evaluation Criteria**

Final course grade will be determined, unless otherwise accorded in class, based on the following scale:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Grade</th>
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<tbody>
<tr>
<td>100-90</td>
<td>A</td>
</tr>
<tr>
<td>89-80</td>
<td>B</td>
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<tr>
<td>79-70</td>
<td>C</td>
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<tr>
<td>69-60</td>
<td>D</td>
</tr>
<tr>
<td>59-0</td>
<td>F</td>
</tr>
</tbody>
</table>

The number of tests and percentages are determined by the instructor. Homework is suggested to be 0% to 15% of the final grade. A midterm exam (suggested: 25% to 30% of final grade) and the final exam (suggested: 30% of final grade). A final research
project, research report or paper review is required. An oral presentation is required. (Suggested: 25% to 30% of final grade).

**Course History**

April, 2002; prepared by Marvi Teixeira, Ph.D., P.E.
May, 2002; revised by Roman Lopez, Ph.D.
Jan, 2008; revised by Marvi Teixeira, Ph.D., P.E.
April, 2008; revised by Marvi Teixera, Ph.D, P.E.

**Bibliography**

By E.S. Gopi
1st Edition
Springer

1st Edition
Prentice Hall

By H. Krishna Garg
1st Edition
CRC Press
ISBN: 0-8493-7178-3

*Fourier-Related Transforms, Fast Algorithms and Applications.* (1997)
By O. Ersoy
1st Edition
Prentice Hall.

By S. D. Stearns and R. A. David
1st Edition
Prentice Hall
ISBN: 0-13-045154-1
Circulant Matrices. (1994)
By P. J. Davis.
2nd Edition
Chelsea Publishing
ISBN: 0-8284-0338-4

by C. S. Burrus and T. W. Parks.
1st Edition
John Wiley & Sons.
ISBN: 0-471-81932-8

By P. M. Embree and B. Kimble.
1st Edition
Prentice Hall

By R. Tolimieri, M. An and C. Lu.
1st Edition
Springer Verlag.
ISBN: 0-387-97118-1

Digital Signal Processing
Applications to Communications and Algebraic Coding Theories
By Salvatore D. Morgera and Harri Krishna
Academic Press Inc.
ISBN: 0-12-506995-2

By R. E. Blahut
1st Edition
Addison Wesley
ISBN: 0-201-10155-6

By C. S. Burrus and T. W. Parks.
1st Edition
John Wiley & Sons.
ISBN: 0-471-81932-8

by D. F. Elliot and K. R. Rao
1st Edition
Academic Press
ISBN: 0-12-237080-6

Number Theory in Digital Signal Processing. (1979)
By J. H. McClellan and C. M. Rader
1st Edition
Prentice Hall
ISBN: 0-13-627349-1

By E. O. Brigham
1st Edition
Prentice Hall