General description

This module treats the main classes of problems in numerical linear algebra: linear systems, least squares problems, and eigenvalue problems, covering both dense and sparse matrices. It provides analysis of the problems along with algorithms for their solution. It also uses MATLAB as a tool for expressing and implementing algorithms and describes some of the key ideas used in developing high-performance linear algebra codes. Applications, such as machine learning and search engines, will be introduced throughout the module.

Aims

To develop understanding of modern methods of numerical linear algebra for solving linear systems, least squares problems, and the eigenvalue problem.

Learning Outcomes

On completion of the module, students will be able to

1. construct some key matrix factorizations using elementary transformations,
2. choose an appropriate numerical method to solve linear systems, least squares problems, and the eigenvalue problem,
3. evaluate and compare the efficiency and numerical stability of different algorithms for solving linear systems, least squares problems, and the eigenvalue problem,
4. design algorithms that exploit matrix structures such as triangularity, sparsity, banded structure, and symmetric positive definiteness,
5. quantify the sensitivity of a linear system or least squares problem to perturbations in the data.

Syllabus

3. Sparse and banded linear systems Storage schemes for banded and sparse matrices. LU factorization, Markowitz pivoting.
Textbooks


Teaching and Learning Methods

30 lectures (two or three lectures per week), with a fortnightly examples class. 
*Special arrangements for 2020 to be advised.*

Assessment

An end of module three hour examination (80%) and coursework (20%) comprising one assignment. 
*Special arrangements for 2020 to be advised.*

Learning Hours

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Staff/student contact</td>
<td>42</td>
</tr>
<tr>
<td>Work on assessments</td>
<td>40</td>
</tr>
<tr>
<td>Private study</td>
<td>68</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
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