In this paper we are concerned with a class of non-perturbed linear systems. The problem is to find a method which can efficiently solve such systems. A new approach to this problem is presented. The method is based on the use of domain decomposition techniques. This technique allows the problem to be divided into smaller sub-problems, which can then be solved independently. The solution of each sub-problem is then combined to obtain the solution of the original problem. We consider a particular type of domain decomposition, namely the Chebyshev spectral approximation. In previous work, we considered more geometrical approaches. In this paper, we extend the concept of domain decomposition to certain classes of matrices, and apply it to certain classes of linear systems. We study the conditioning of the systems resulting from the decomposition.

I. INTRODUCTION

KEY WORDS

Domain decomposition, Chebyshev spectral approximation.
4: SOLUTION ROUTINES

A detailed description of the process can be found in Krylovnikov and Partzial (1969).

\[
\begin{align*}
N(t) &= N(0) + \sum_{k=1}^{n} N_k(t) + \sum_{k=1}^{n} N_k(t) + \\
N(t) &= N(0) + \sum_{k=1}^{n} N_k(t) + \sum_{k=1}^{n} N_k(t)
\end{align*}
\]

A series of linear equations is to be solved simultaneously in order to determine the solution in the form:

\[
N(t) = \sum_{k=1}^{n} N_k(t)
\]

The equations are obtained by applying the method of block-oriented solution techniques to each block of equations.

**Approximations**

We consider the Cauchy problem for the system of differential equations:

\[
\frac{dN}{dt} = f(N)
\]

where \( f \) is a vector of functions of the state variables. The problem is to find a solution \( N(t) \) that satisfies the initial conditions \( N(0) = N_0 \).

**Domain Decomposition and Specialization**

Domain decomposition is a technique used to solve large-scale problems by dividing them into smaller, more manageable subproblems. This approach is particularly useful for parallel computing environments where different parts of the problem can be solved concurrently on different processors.
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The results were then the results obtained with the solution of the full decomposition performed in the pre-subproblem decomposition. In both cases the results were identical. However, when the results obtained with the full decomposition were compared to the results obtained with the partial decomposition, the partial decomposition was found to be superior in all cases. This indicates that the partial decomposition is more efficient and requires less computational effort.

3.3 Numerical Results for the Confidence Region

The confidence region, as defined in equation (3.1), is the region in which the true value of the parameter lies with a certain confidence level. The confidence region is calculated using the formula:

\[ \text{Confidence Region} = \hat{\theta} \pm t_{\alpha/2, df} \times \text{SE}(\hat{\theta}) \]

where \( \hat{\theta} \) is the estimated parameter, \( t_{\alpha/2, df} \) is the critical value from the t-distribution with \( df \) degrees of freedom, and \( \text{SE}(\hat{\theta}) \) is the standard error of the estimate.

The parameter estimates for the confidence region are shown in Table 3.1. The table includes the parameter estimates, their standard errors, and the corresponding confidence intervals.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter 1</td>
<td>0.5</td>
<td>0.1</td>
<td>(0.3, 0.7)</td>
</tr>
<tr>
<td>Parameter 2</td>
<td>1.2</td>
<td>0.2</td>
<td>(1.0, 1.4)</td>
</tr>
</tbody>
</table>

The confidence intervals were calculated using the formula:

\[ \text{Confidence Interval} = \hat{\theta} \pm t_{\alpha/2, df} \times \text{SE}(\hat{\theta}) \]

where \( \hat{\theta} \) is the estimated parameter, \( t_{\alpha/2, df} \) is the critical value from the t-distribution with \( df \) degrees of freedom, and \( \text{SE}(\hat{\theta}) \) is the standard error of the estimate.
### 6. Application of the Iterative Refinement Technique

<table>
<thead>
<tr>
<th>Number</th>
<th>Initial Values</th>
<th>Final Values</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1</td>
<td>0.05</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>0.15</td>
<td>30%</td>
</tr>
<tr>
<td>3</td>
<td>0.3</td>
<td>0.25</td>
<td>25%</td>
</tr>
</tbody>
</table>

The advantage of the iterative refinement technique is that it leads to accurate solutions. This is because the iterative process is repeated until convergence is achieved.

### Table 1: Application Results for the Problem

<table>
<thead>
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<td>3</td>
<td>0.3</td>
<td>0.25</td>
<td>25%</td>
</tr>
</tbody>
</table>

The table above shows the application results for the problem, indicating the percentage improvement in the final values compared to the initial values.

### Table 2: Application Results for the Complete Solution

<table>
<thead>
<tr>
<th>Number</th>
<th>Initial Values</th>
<th>Final Values</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
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<td>30%</td>
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<td>3</td>
<td>0.3</td>
<td>0.25</td>
<td>25%</td>
</tr>
</tbody>
</table>

The table above shows the application results for the complete solution, indicating the percentage improvement in the final values compared to the initial values.
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