Study notes

Math 228B
Numerical Solution of Differential Equations

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Contents

1 How to decide which fractional stepping to use?

Given a mixed PDE such as $u_t = Au + Bu$ where A, B are constant matrices.

Let standard stepping be

$$u^* = N_A(u^n, k)$$
$$u^{n+1} = N_B(u^*, k)$$

Where N_A and N_B are numerical schemes to solve the problem $u_t = Au$ and $u_t = Bu$ respectively. k in the above is the time step.

Let Strang splitting be

$$u^* = N_A(u^n, k/2)$$
$$u^{**} = N_B(u^*, k)$$
$$u^{n+1} = N_A(u^{**}, k/2)$$

Now, assuming that N_A and N_B are each second order accurate in time. Which of the above two schemes should one select?

Algorithm

```
---- standard stepping
IF A,B commute THEN
   standard stepping is second order in time
ELSE
   standard stepping is first order in time
END IF


---- Strang
IF A,B commute THEN
   strang gives second order accuracy in time
ELSE
   strang also gives second order accuracy in time
END IF
```

Hence, from the above, the conclusion is that

```
IF A,B commute THEN
   select standard stepping (simpler)
ELSE
   select Strang (more accurate)
END IF
```

some notes from the net HTML