FYS3150 - Project 1

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September 3, 2019

Project 1 a)

For $i = 0$ and $i = n$ the boundary conditions gives us $v(0) = v(1) = 0$.

For $i = 1$

$$-\frac{v_2 + v_0 - 2v_1}{h^2} = f_1$$

For $i = 2$

$$-\frac{v_3 + v_1 - 2v_2}{h^2} = f_2$$

For $i = n - 1$

$$-\frac{v_n + v_{n-2} - 2v_{n-1}}{h^2} = f_{n-1}$$

If you multiply both sides by h^2

$$-v_2 + v_0 - 2v_1 = h^2 \cdot f_1$$

$$-v_3 + v_1 - 2v_2 = h^2 \cdot f_2$$

$$-v_n + v_{n-2} - 2v_{n-1} = h^2 \cdot f_{n-1}$$

Which you can rewrite as a linear set of equations on the form $A\hat{v} = \tilde{b_i}$ where

$$A = \begin{bmatrix} 2 & -1 & 0 & 0 & \dots & 0 \\ -1 & 2 & -1 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & & \vdots \\ 0 & 0 & 0 & \dots & -1 & 2 \end{bmatrix} \qquad \hat{v} = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_{n-1} \end{bmatrix} \qquad \tilde{b_i} = \begin{bmatrix} \tilde{b_1} \\ \tilde{b_2} \\ \vdots \\ \tilde{b_{n-1}} \end{bmatrix}$$

And $\tilde{b_i} = h^2 \cdot f_i$

Project 1 b)

Den generelle algoritmen blir som følgende:

$$\tilde{c}[i] = \frac{c[i]}{b[i] - a[i] * \tilde{c}[i-1]}$$

$$\tilde{d}[i] = \frac{d[i] - a[i] * \tilde{d}[i-1]}{b[i] - a[i] * \tilde{c}[i-1]}$$

Siden nevneren er lik i begge brøker kan vi regne ut den først for hver i. Da får vi 6 floating point operations per n, altså $6n$ FLOPS.