Numerical Exercise #2

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November 6, 2024

1 Question #1

Numerical solution for the bare system
keff (scientific format with 5 significant digits): 1.0968236369773214
net current at the core boundary (scientific format with 5 significant digits): $J = \frac{\phi_2 - \phi_1}{dx} =$ 0.12543

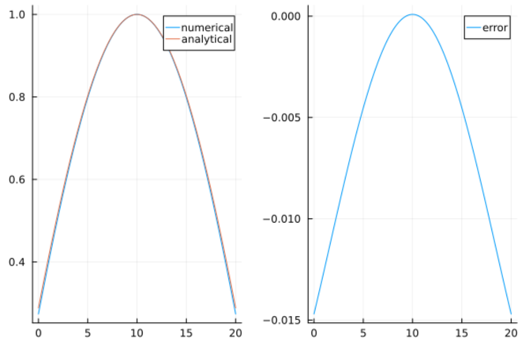

Figure 1: Flux in the bare reactor for a mesh size of 0.1 cm and Distance between numerical and algebraic solutions at each mesh point for a mesh size of 0.1 cm.

2 Question #2

Analytical solution for the bare system
For the bare reactor the Equation becomes

$$\frac{d^2\phi}{dz^2} + B_m^2 \phi = 0$$

where B_m is the material Buckling. It is solved by $\phi(z) = A\cos(Bz) + C\sin(Bz)$. Due to the symmetric boundary conditions of the problem, we know that $C = 0$. The geometric buckling is $B^2 = \left(\frac{\pi}{H+2d}\right)^2$. A steady state is reached, when the material Buckling is equal to the numerical buckling, in this case, k_{eff} can be calculated by

$$k_{\text{eff}} = \frac{k_\infty}{1 + L^2 B^2}$$

keff (scientific format with 5 significant digits):
net current at the core boundary (scientific format with 5 significant digits): 0.28856 (left and right)

3 Question #3

Numerical solution for the reflected system
keff (scientific format with 5 significant digits):1.0172
net current at the core boundary (scientific format with 5 significant digits): 0.04153

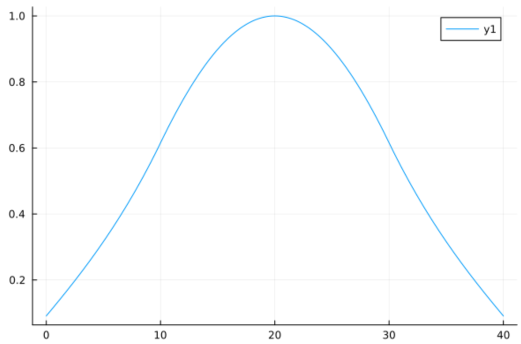

Figure 2: Flux in the reflected reactor for a mesh size of 0.1 cm.