READ ME

Welcome to USFKAD (*nee* TRUKAD), the software for solving partial differential equations analytically, by separation of variables. If you find this software is of value to you, please consider making a donation to USF students via the Allen Gondeck scholarship fund, through Prof. A. D. Snider, University of South Florida, ENB 118, Tampa FL 33620. (Thank you.)

The task of constructing complete solutions by separation of variables is quite tedious, and the software can do this for you only if you follow the format/notation conventions precisely.

The current (4/1/10) version USFKAD_V2.exe handles (homogeneous or nonhomogeneous) (mixed) Dirichlet, Neumann, periodic, constant-coefficient Robin boundary conditions, singular boundary conditions, and Sommerfeld (incoming/outgoing) boundary conditions for the homogeneous/nonhomogeneous Poisson, diffusion, or wave equations, in the time, frequency, or Laplace domains. It presumes you have installed Basic MikTex 2.8 on your pc, available from http://miktex.org/2.8/setup .

You will have to label the dimensions of your domain to conform to one of the following conventions:

1. $0 < x,y,z,\theta < X,Y,Z,\Theta$
2. $0 < x,y,z < \infty$ (Do not use $-\infty < x,y,z < X,Y,Z$)
3. $-\infty < x,y,z < \infty$
4. $0 < \theta < 2\pi$ (periodic)
5. $0 < a < r < b < \infty$
6. $0 < a < r < \infty$
7. $0 < r < b < \infty$
8. $0 < r < \infty$
9. $0 < \theta < 2\pi$ and $0 < \phi < \pi$ (spherical coordinates)

The units for the Laplace/Poisson equation are presumed to take the form

$$\nabla^2\psi + f_{interior} = 0$$ (Note the sign convention for $f_{interior}$.)

The units for the time-dependent diffusion equation are presumed to take the form

$$\partial\psi/\partial t = \nabla^2\psi + f_{interior} .$$

The units for the time-dependent wave equation are presumed to take the form

$$\partial\psi/\partial t = \nabla^2\psi + f_{interior} .$$

The units for the s-domain diffusion equation are presumed to take the form

$s\psi - \psi_{t=0} = \nabla^2\psi + f_{interior}$.

The units for the s-domain wave equation are presumed to take the form

$s^2\psi - s\psi_{t=0} - \partial\psi/\partial t_{t=0} = \nabla^2\psi + f_{interior}$.

The units for the frequency-domain wave equation are presumed to take the form

$-\omega^2\psi = \nabla^2\psi + f_{interior}$.

Dirichlet boundary conditions take the form

$\psi(0,y,z) = f_{x=0}(y,z)$; $\psi(X,y,z) = f_{x=X}(y,z)$

(and similarly for y, z, r, and θ).

USFKAD encodes Neumann boundary conditions in the form

$\partial\psi(0,y,z)/\partial x = f_{x=0}(y,z)$; $\partial\psi(X,y,z)/\partial x = f_{x=X}(y,z)$

(and similarly for y, z, r, and θ). **Note that the relevant partial derivative interpreted by USFKAD will *not* always be the *external* normal derivative. You will have to express your normal derivative in terms of (±)$\partial\psi/\partial x$, etc..**

Robin boundary conditions take the form

$\alpha_{x=0}\,\psi(0,y,z) + \partial\psi(0,y,z)/\partial x = f_{x=0}(y,z)$;

$\alpha_X\,\psi(X,y,z) + \partial\psi(X,y,z)/\partial x = f_{x=X}(y,z)$

(and similarly for y, z, r, and θ). **Note that the relevant partial derivative interpreted by USFKAD will *not* always be the *external* normal derivative. You will have to express your normal derivative in terms of (±)**$\partial\psi/\partial x$ **, etc..** The coefficient α is presumed constant.

Singular boundary conditions apply where the radial coordinate, r or ρ, is zero, or if the boundary is at infinity; however, in the frequency domain for the wave equation, you must specify the Sommerfeld condition (incoming or outgoing wave) at infinity.

Periodic boundary conditions usually apply when there are no actual boundaries for the angle θ, and the solution simply "wraps around."

To use the software, doubleclick on the .exe file, and follow the menu instructions *carefully*. Give the name of your output file a .tex subscript, like “DavesPDE.tex”. This version of the software does not alert the user if inconsistent parameters are input - it simply fails to produce an output file.

The final instruction states “DONE. Hit a letter to finish.” Type any letter *and press enter*. (Also press Enter if you get the message ""! Latex Error: File ‘tcilatex.tex' not found".) Either view the .dvi result (in the same folder as you have saved ‘USFKAD_V2.exe’) or open the Command Prompt window (under

“Accessories”), change directory to the same folder as you have saved ‘USFKAD_V2.exe’, type “dvipdfm DavesPDE” to convert it to pdf, and print out. You may make format changes to the .tex file if you wish.

Please inform A. D. Snider by email (snider@eng.usf.edu) if you feel the software has returned an incorrect answer, or if you need elaboration on the answer; include a complete problem statement and the output .tex file, and your comments.

Enjoy!

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Dave Snider