PEEI 4.0.0.0 quick guide

PEEI calculates numerical solutions of systems of partial differential equations that have number of equations equal or greater the number of unknown functions.

A system of partial differential equations $\underline{\mathfrak{M}}$, is constituted by $\mathfrak{m}$ equations of the type $\mathfrak{EQ}(\underline{x})=0$ (i.e. $\underline{\mathfrak{M}}\equiv\underline{\mathfrak{M}}\langle\underline{x}\rangle\equiv\{\mathfrak{EQ}_m(\underline{x})=0;m=1,\mathfrak{m}\}$) where they appear $\mathfrak{mm}$ unknown functions $\{F_{\mathfrak{m}}(\underline{x});\mathfrak{m}=1,\mathfrak{mm}\}$ and $\mathfrak{nn}$ known functions $\{F_{N\mathfrak{m}}(\underline{x});\mathfrak{m}=\mathfrak{mm}+1,\mathfrak{M}\}$ (of which $\mathfrak{m}\geq\mathfrak{mm}$, $\mathfrak{M}\equiv\mathfrak{mm}+\mathfrak{nn}$, $\mathfrak{nn}\geq 0$), and where the $\underline{x}$ (of which $\underline{x}\equiv\{x_n;n=1,\mathfrak{n}\}$) are the coordinates of an $\mathfrak{n}$-dimensional coordinate system.

An $\mathfrak{EQ}_m(\underline{x})$ is a sum of $\mathfrak{a}_m$ addends, i.e. $\mathfrak{EQ}_m(\underline{x})\equiv\Sigma_{a=1,\mathfrak{a}\langle m\rangle}(\mathfrak{A}_{ma}(\underline{x}))$ of which $\mathfrak{a}_m>0$.

An addend $\mathfrak{A}_{ma}(\underline{x})$ is a product of a constant $\mathfrak{K}_{ma}$ and $\mathfrak{b}_{ma}$ factors, i.e. $\mathfrak{A}_{ma}(\underline{x})\equiv\mathfrak{K}_{ma}\cdot\Pi_{b=1,\mathfrak{b}\langle m,a\rangle}(\mathfrak{F}_{mab}(\underline{x}))$ of which $\mathfrak{b}_{ma}\geq 0$ and $\Pi_{b=1,0}(\mathfrak{F}_{mab}(\underline{x}))=1$.

A factor $\mathfrak{F}_{mab}(\underline{x})$ is an exponentiation with base $\mathfrak{B}_{mab}(\underline{x})$ and exponent $\mathfrak{E}_{mab}$, i.e. $\mathfrak{F}_{mab}(\underline{x})\equiv(\mathfrak{B}_{mab}(\underline{x}))^{\mathfrak{E}\langle m,a,b\rangle}$ with $\mathfrak{E}_{mab}\geq 0$.

A base $\mathfrak{B}_{mab}(\underline{x})$ is a known function or a partial derivative of a unknown function, i.e. $\mathfrak{B}_{mab}(\underline{x})\equiv\partial^{\mathfrak{o}\langle m,a,b\rangle}\mathbb{F}_{\mathfrak{m}\langle m,a,b\rangle}(\underline{x})/\partial x_{\mathfrak{n}\langle m,a,b,1\rangle}\partial x_{\mathfrak{n}\langle m,a,b,2\rangle}\ldots\partial x_{\mathfrak{n}\langle m,a,b,\mathfrak{o}\langle m,a,b\rangle\rangle}$ of which $\mathfrak{m}_{mab}\in\{\mathfrak{m}=1,\mathfrak{M}\}$, $\{\mathbb{F}_{\mathfrak{m}}(\underline{x});\mathfrak{m}=1,\mathfrak{M}\}\equiv\{\{F_{\mathfrak{m}}(\underline{x});\mathfrak{m}=1,\mathfrak{mm}\},\{F_{N\mathfrak{m}}(\underline{x});\mathfrak{m}=\mathfrak{mm}+1,\mathfrak{M}\}\}$, $\mathfrak{O}_{mab}\geq 0$, $\mathfrak{O}_{mab}=0$ if $\mathfrak{m}_{mab}\in\{\mathfrak{m}=\mathfrak{mm}+1,\mathfrak{M}\}$, $\{\mathfrak{n}_{mabc}\in\{n=1,\mathfrak{n}\};c=1,\mathfrak{O}_{mab}\}$.

PEEI calculates approximate numerical values of the $\{F_{\mathfrak{m}}(\underline{x});\mathfrak{m}=1,\mathfrak{mm}\}$ in the points $\{\underline{x}_p;p=1,\mathfrak{p}\}$ of which $\underline{x}_p\equiv\{x_{pn};n=1,\mathfrak{n}\}$, i.e. calculates the $\{\mathfrak{f}_{\mathfrak{m}p};\mathfrak{m}=1,\mathfrak{mm};p=1,\mathfrak{p}\}$ of which $\mathfrak{f}_{\mathfrak{m}p}\cong F_{\mathfrak{m}}(\underline{x}_p)$.

In http://www.giacomo.lorenzoni.name/peei_4.0.0.0/screenshots.htm are three typical screenshots (initial, intermediate and final) of GUI (Graphical User Interface) of PEEI.

Are placed

𝕒≡{first execution without memory}

𝕓≡{first execution with memory}

𝕪≡{later execution}

𝕠≡{normal procedure}

𝕖≡{other procedure}

𝕫≡{normal method}

𝕟≡{other method}

α≡{system of partial differential equations}

β≡conditions

γ≡{points coordinates}

δ≡{mesh memory}

ε≡solution

ζ≡{functions intervals}

The input of PEEI is entirely in its GUI and is visually subdivided between one part labeled “necessary” and one part labeled “optional”.

The necessary part is constituted by

1) The option 𝕒.𝕧.𝕓.𝕧.𝕪.

2) The names of two existing files, that have .txt extension, labeled respectively α and β, and whose respective names are typically MAD.txt and COND.txt.

3) The name of an existing file: with .txt extension, labeled γ, whose typical name is POINTS.txt, if the option 𝛂.𝛎.𝛃 is active; or with extension .bin, labeled δ, whose typical name is POINTS.bin, if the option 𝛾 is active.

The optional part is constituted by

1) The option 𝛅.𝛎.𝛆, if the option 𝛂.𝛎.𝛃 is active.

2) The option 𝛇.𝛎.𝛈.

3) The name of a file labeled ε and whose typical name is PEEI_SOL.txt.

4) The name of a file labeled ζ (which may be absent), if the option 𝛈 is active.

The descriptions of applications available in http://www.giacomo.lorenzoni.name/peei_4.0.0.0/, contain (useful like examples) specifications of these files.

The α, γ, β and ζ are text files written by the user before the execution of PEEI. The data contained in these files are numbers separated by characters (e.g. letters, punctuation, empty spaces, and control characters as "carriage return" or "line feed") that not contribute to expressing numbers: in these files PEEI considers only the words that express numbers, and then ignores any word that does not express a number.

Below is considered absent any $\{ş_i;i=\dot{\imath},\ddot{\imath}\}$ of which $\dot{\imath}>\ddot{\imath}$.

The δ and ε are files, respectively binary and of text, written by PEEI and available for the user after its execution.

The file δ corresponds biuniquely to the file γ, and is written by PEEI if the option 𝛃 is active. The option 𝛾 (that demands the file δ) is less expensive of the op-

tion 𝕒.𝕍.ß (that demands the file γ).

The file α must contain neatly the following data:

- 𝖓 i.e. the number of coordinates, of which 𝖓>0;
- 𝖒 i.e. the number of equations, of which 𝖒>0;
- 𝖒 i.e. the number of unknown functions, of which 𝖒≥𝖒;
- 𝖒 i.e. the number of known functions, of which 𝖒=𝕸−𝖒≥0;
- $\{\mathfrak{a}_m,\{\kappa_{ma},\mathfrak{b}_{ma},\{E_{mab},\Theta_{mab},\Gamma_{mab},\{\Gamma_{mabc};c=1,\Theta_{mab}\};b=1,\mathfrak{b}_{ma}\};a=1,\mathfrak{a}_m\};m=1,\mathfrak{m}\}$

The file γ must contain neatly the numerical values

- $\{x_{pn};n=1,\mathfrak{n};p=1,\mathfrak{P}\}$ i.e. for each $\underline{x}_p$ must contain the $\{x_{pn};n=1,\mathfrak{n}\}$. Must be $\mathfrak{P}\geq 3$.

The program PEEI, besides the $\{F_{N\mathfrak{m}}(\underline{x}_p);\mathfrak{m}=\mathfrak{m}+1,\mathfrak{M};p=1,\mathfrak{P}\}$, uses also some other conditions that are contained in the file β, i.e. numerical values that some partial derivatives of the unknown functions have in someone of the $\{\underline{x}_p;p=1,\mathfrak{P}\}$. The file β contain neatly the values

- $\{F_{N\mathfrak{m}}(\underline{x}_p);\mathfrak{m}=\mathfrak{m}+1,\mathfrak{M};p=1,\mathfrak{P}\}$
- $\{p_p,\mathfrak{m}_p,\Theta_p,\{n_{pa};a=1,\Theta_p\},v_p;p=1,\mathbb{P}\}$

of which $\mathfrak{P}\geq 0$ and where: the $\{F_{N\mathfrak{m}}(\underline{x}_p);\mathfrak{m}=\mathfrak{m}+1,\mathfrak{M};p=1,\mathfrak{P}\}$ are absent if $\mathfrak{M}=0$, v_p is the numerical value of a correspondent $\partial^{\Theta\langle p\rangle}F_{\mathfrak{m}\langle p\rangle}(\underline{x}_{p\langle p\rangle})/\partial x_{n\langle p,1\rangle}\partial x_{n\langle p,2\rangle}\ldots\partial x_{n\langle p,\Theta\langle p\rangle\rangle}$ of which $p_p\in\{p=1,\mathfrak{P}\}$ $\mathfrak{m}_p\in\{\mathfrak{m}=1,\mathfrak{m}\}$ $\Theta_p\geq 0$ $\{n_{pa}\in\{n=1,\mathfrak{n}\};a=1,\Theta_p\}$.

If the option ℕ is active, is possible the file ζ that contain the values

- $\{𝕞_k,A_k,B_k;k=1,𝕜\}$

of which $𝕜\leq𝕟$ $𝕞_k\in\{𝕞=1,𝕟\}$ $A_k\leq F_{𝕞\langle k\rangle}(\underline{x})\leq B_k$. The file ζ not is necessary, but the option ℕ demands internally the $\{A_𝕞,B_𝕞;𝕞=1,𝕟\}$ and if a couple $\{A_𝕞,B_𝕞\}$ not is notified by ζ are adopted the $A_𝕞=-1E20$ $B_𝕞=1E20$. The execution is better if each $B_𝕞-A_𝕞$ is smaller.

The file ε contains ₽ rows (one for each of the $\{\underline{x}_p;p=1,₽\}$), and a row p contains successively: the number p, the symbol ":" and an empty space, the $\{ƒ_{𝕞p};𝕞=1,𝕟\}$ separated by two empty spaces.

Other information on PEEI are available at

http://www.giacomo.lorenzoni.name/peei_4.0.0.0/

http://www.giacomo.lorenzoni.name/mrnmad/