PEEI v.2.2.0.0 quick guide

The program PEEI calculates a numerical solution of almost all the systems of partial differential equations who have number of equations equal or greater the number of unknown functions.

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

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

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

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

A base $\mathsf{B}_{mab}(\underline{x})$ is a known function or a partial derivative of a unknown function, i.e. $\mathsf{B}_{mab}(\underline{x})\equiv\partial^{\cancel{\mathrm{o}}\langle m,a,b\rangle}\mathbb{F}_{\mathsf{m}\langle m,a,b\rangle}(\underline{x})/\partial x_{\mathsf{n}\langle m,a,b,1\rangle}\partial x_{\mathsf{n}\langle m,a,b,2\rangle}\ldots\partial x_{\mathsf{n}\langle m,a,b,\cancel{\mathrm{o}}\langle m,a,b\rangle\rangle}$ of which $\mathsf{m}_{mab}\in\{\mathbb{m}=1,\cancel{\mathbb{M}}\}$, $\{\mathbb{F}_{\mathbb{m}}(\underline{x});\mathbb{m}=1,\cancel{\mathbb{M}}\}\equiv\{\{\mathrm{F}_{\mathbb{m}}(\underline{x});\mathbb{m}=1,\cancel{\mathbb{m}}\},\{\mathrm{F}_{\mathrm{N}\mathbb{m}}(\underline{x});\mathbb{m}=\cancel{\mathbb{m}}+1,\cancel{\mathbb{M}}\}\}$, $\cancel{\mathrm{o}}_{mab}\geq0$, $\cancel{\mathrm{o}}_{mab}=0$ if $\mathsf{m}_{mab}\in\{\mathbb{m}=\cancel{\mathbb{m}}+1,\cancel{\mathbb{M}}\}$, $\{\mathsf{n}_{mabc}\in\{n=1,\cancel{\mathrm{n}}\};c=1,\cancel{\mathrm{o}}_{mab}\}$.

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

They are placed

$\mathbb{\alpha}\equiv\{$first execution without memory$\}$
$\mathbb{\beta}\equiv\{$first execution with memory$\}$
$\mathbb{\gamma}\equiv\{$later execution$\}$
$\mathbb{\delta}\equiv\{$normal procedure$\}$
$\mathbb{\varepsilon}\equiv\{$better procedure$\}$
$\alpha\equiv\{$system of partial differential equations$\}$
$\beta\equiv$conditions
$\gamma\equiv\{$points coordinates$\}$
$\delta\equiv\{$mesh memory$\}$
$\varepsilon\equiv$solution

In http://www.giacomo.lorenzoni.name/peei_2.2.0.0/screenshots.htm are three typical screenshots (initial, intermediate, and final) of GUI (Graphical User Interface) of PEEI.

The input of PEEI is entirely in its GUI, and is subdivided (also visually) between one necessary and one optional part.

The necessary part is constituted by

1) The option $\mathbb{\alpha}.\dot{\vee}.\mathbb{\beta}.\dot{\vee}.\mathbb{\gamma}$.

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 $\mathbb{\alpha}.\dot{\vee}.\mathbb{\beta}$ is active; or with extension .bin, labeled δ, whose typical name is PEEI_mem_0.bin, if the option $\mathbb{\gamma}$ is active.

The optional part is constituted by

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

2) The name of a file labeled ε and whose typical name is PEEI_sol_0.txt.

The descriptions of applications available in http://www.giacomo.lorenzoni.name/peei_2.2.0.0/, contain (useful like examples) specifications of these files.

The α, γ and β are text files written from the user before the execution of PEEI. The data contained in these files are numbers (is allowed also a format like 1.23E+04) separated by characters who are not numbers (e.g. letters, punctuation, empty spaces, and control characters as "carriage return" or "line feed"). In these files a {$ş_i$;i=ɨ,ɨ} of which ɨ>ɨ, is considered absent. 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 option α.V.β (that demands the file γ).

The option ε is more precise but more expensive of the option δ.

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 $\cancel{\mathbf{m}}>0$.

- $\cancel{\mathbb{m}}$

i.e. the number of unknown functions, of which $\cancel{\mathbf{m}} \geq \cancel{\mathbb{m}}$.

- $\cancel{\mathit{m}}$

i.e. the number of known functions, of which $\cancel{\mathit{m}} = \cancel{\mathbb{M}} - \cancel{\mathbb{m}} \geq 0$.

- $\{\cancel{a}_{m},\{\mathsf{K}_{ma},\cancel{b}_{ma},\{\mathsf{E}_{mab},\cancel{\mathsf{O}}_{mab},\mathsf{m}_{mab},\{\mathsf{n}_{mabc};c=1,\cancel{\mathsf{O}}_{mab}\};b=1,\cancel{b}_{ma}\};a=1,\cancel{a}_{m}\};m=1,\cancel{\mathbf{m}}\}$

of which $\cancel{a}_{m}>0$ $\cancel{b}_{ma}\geq 0$ (and $\Pi_{b=1,0}(\mathsf{F}_{mab}(\underline{x}))=1$).

The file γ must contain neatly the numerical values

- $\{x_{pn};n=1,\cancel{n};p=1,\cancel{p}\}$

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

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

- $\{F_{N\mathbb{m}}(\underline{x}_{p});\mathbb{m}=\cancel{\mathbb{m}}+1,\cancel{\mathbb{M}};p=1,\cancel{p}\}$
- $\{p_{p},\mathbb{m}_{p},\cancel{\theta}_{p},\{n_{pa};a=1,\cancel{\theta}_{p}\},v_{p};p=1,\cancel{\mathbb{p}}\}$

of which $\cancel{\mathbb{p}}\geq 0$; where the $\{F_{N\mathbb{m}}(\underline{x}_{p});\mathbb{m}=\cancel{\mathbb{m}}+1,\cancel{\mathbb{M}};p=1,\cancel{p}\}$ are absent if $\cancel{\mathit{m}}=0$; where v_{p} is the numerical value of a correspondent $\partial^{\cancel{\theta}\langle p\rangle}F_{\mathbb{m}\langle p\rangle}(\underline{x}_{p\langle p\rangle})/\partial x_{n\langle p,1\rangle}\partial x_{n\langle p,2\rangle}\ldots\partial x_{n\langle p,\cancel{\theta}\langle p\rangle\rangle}$ of which $p_{p}\in\{p=1,\cancel{p}\}$ $\mathbb{m}_{p}\in\{\mathbb{m}=1,\cancel{\mathbb{m}}\}$ $\cancel{\theta}_{p}\geq 0$ $\{n_{pa}\in\{n=1,\cancel{n}\};a=1,\cancel{\theta}_{p}\}$.

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

Other information on PEEI are available at

http://www.giacomo.lorenzoni.name/peei_2.2.0.0/

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