

## **MathType for Making and Managing Equations**

### *Introduction to MathType*

MathType is a piece of software that allows you to easily create and manage equations inside of a Word document or a PowerPoint document. It is perfect for making equations inside of a thesis or dissertation, assuming that you will be using Microsoft Word to write your thesis or dissertation (If you use Latex to write your thesis or dissertation, then you do not need MathType.) It is also great for making equations inside of a PowerPoint presentation. When you install MathType, it will automatically create a tab within Microsoft Word and Microsoft PowerPoint, so that you can then easily use MathType when you are working on a Word or PowerPoint document.

MathType is created by a company called Design Science, the same company that makes “Equation Editor”, which is the standard tool that already comes with Microsoft word for creating equations. Think of MathType as a “beefed-up” version of the standard Equation Editor. MathType allows you many more options than Equation Editor: it gives you many more choices of math symbols, it makes nicer looking equations, and it allows for the automatic numbering and referencing of equation numbers, as discussed more below.

MathType almost always knows how to properly format the symbols that appear in equations, so you do not have to worry about it. For example, it knows that math symbols and subscripts and superscripts that are variables should be italicized, as in  $(x, y, z)$  and  $P_i$ , while subscripts and superscripts that are complete words or abbreviations should normally not be in italics, as in  $P_{\max}$ . It also know that the names of functions should not be in italics, such as in  $w = \exp(z)$ .

When you have a document such as a thesis or dissertation that has many equations in it, the automatic numbering and referencing of equations that MathType provides will be a tremendous help. For example, just imagine that you finish writing your document and it has 200 equations in it. You then discover that you really want to add a new equation between the existing equations (1) and (2) in your document. What do you do? If you had typed manually (“hardwired”) in each equation number within your document, then you would now have to go back and retype all of the equation numbers, starting with the second one. That’s bad enough. But what’s even worse is that everywhere inside the document that you reference an equation, you have to change this as well. For example, you may have a sentence somewhere in your document that says “...as seen in Eq. (37)”. This now has to be changed to become “...as now seen in Eq. (38)”. Hunting through the entire document carefully to make sure that you don’t miss any equation references that need to be updated can be a big chore. MathType makes this unnecessary, as it can automatically number equations and automatically reference them for you. Therefore, each time you add or delete an equation, all of the equation numbers throughout the document are automatically updated, both in the equation numbers themselves and in the references to the equation numbers that you have inside the text.

### *Using MathType*

MathType makes creating equations easy. Here is an example of an inline equation:  $y = x^2$ . MathType can also easily create “displayed” equations (equations that appear by themselves on a separate line) such as this:

$$Z^{TM} = \frac{k_z}{\omega \epsilon} = \frac{(k^2 - k_t^2)^{1/2}}{\omega \epsilon} = \frac{-j\sqrt{k_t^2 - k^2}}{\omega \epsilon}. \quad (1)$$

MathType can automatically insert equation numbers and update them each time a new equation is added or deleted. For example, the number “(1)” that is in the right margin after the above equation was not typed or “hardwired” into the Word document. MathType added this number automatically. If we add a second equation, MathType will automatically number it sequentially, as in this example:

$$Z^{TE} = \frac{\omega\mu}{k_z} = \frac{\omega\mu}{(k^2 - k_t^2)^{1/2}} = \frac{\omega\mu}{-j\sqrt{k_t^2 - k^2}}. \quad (2)$$

Once again, the “(2)” in the right margin above was not typed into the Word document, but added automatically by MathType. If a new equation is now added immediately after Eq. (1) in the above example, then Eq. (2) above will automatically get renumbered by MathType to become Eq. (3).

MathType allows you to easily reference a particular equation as well. For example, we might want to say something like this: “The wavenumber  $k_z$  appears in Eq. (2) for the  $TE_z$  wave impedance.” Note that the number “(2)” in the previous sentence was not typed or “hardwired” into the Word document. MathType automatically added it into the sentence.

If a new equation is added after Eq. (1) and before Eq. (2) in the above example, then the “(2)” appearing in the above sentence that references it (“...appears in Eq. (2)...”), will be automatically changed to become a “(3)”.

MathType allows for a wide variety of symbols and notations, including vectors, matrices, integrals, etc. To get the point across, here are a couple of examples:

$$\underline{\underline{\epsilon}} = \begin{bmatrix} \epsilon_{xx} & \epsilon_{xy} & \epsilon_{xz} \\ \epsilon_{yx} & \epsilon_{yy} & \epsilon_{yz} \\ \epsilon_{zx} & \epsilon_{zy} & \epsilon_{zz} \end{bmatrix}, \quad \underline{\underline{\mu}} = \begin{bmatrix} \mu_{xx} & \mu_{xy} & \mu_{xz} \\ \mu_{yx} & \mu_{yy} & \mu_{yz} \\ \mu_{zx} & \mu_{zy} & \mu_{zz} \end{bmatrix} \quad (3)$$

$$\int_V -\frac{1}{2}(\underline{E} \cdot \underline{J}^{i*} + \underline{M}^i \cdot \underline{H}^*) dV = \oint_S \underline{S} \cdot \hat{n} dS + 2j\omega \int_V \left( \frac{1}{4} \mu' |\underline{H}|^2 - \frac{1}{4} \epsilon'_c |\underline{E}|^2 \right) dV + \int_V \left( \frac{1}{2} \omega \epsilon''_c |\underline{E}|^2 + \frac{1}{2} \omega \mu'' |\underline{H}|^2 \right) dV. \quad (4)$$

### Getting MathType

You can get MathType by going to the website for it:

<https://www.wiris.com/en/mathtype>

The software is not free, but there is an academic discount, so it is quite affordable (as of this date it is \$39.95/year for students). There is also a 30 day free trial-version of the software that you can download. If you install the free trial-version and do not purchase the software, then after 30 days all of the MathType fonts still remain on your computer. Even if you do not intend to use MathType in the future, it is still good to have the MathType fonts on your computer. This will make it easy for you to read Word documents and PowerPoint presentations that others might send you that have equations within them that were created with MathType.