

# BzzMath

by

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Buzzi-Ferraris, G., *"BzzMath: Numerical libraries in C++"*, Politecnico di Milano, [www.chem.polimi.it/homes/gbuzzi](http://www.chem.polimi.it/homes/gbuzzi)

Buzzi-Ferraris, G., Manenti, F., "BzzMath: Library Overview and Recent Advances in Numerical Methods", *Computer-Aided Chemical Engineering*, 30(2), 1312-1316, 2012

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## **BzzMath** library upgrading

### **WARNING**

Some portions of the tutorial and of the same **BzzMath** library are in progress for upgrading, extension, and revision.

For any problem you may encounter using the **BzzMath** library please contact the Author at: [guido.buzziferraris@polimi.it](mailto:guido.buzziferraris@polimi.it)

Users are kindly pleased to point out any kind of bug or problem in general to fix them.

**BzzMath** is constantly upgraded. You can find the last version at:

[www.chem.polimi.it/homes/gbuzzi](http://www.chem.polimi.it/homes/gbuzzi)

## **BzzMath library requirements**

### **WARNING**

BzzMath is currently available to run under **Windows** systems with **Microsoft Visual C++ 6.0, 2008, 2010, 2013 and Intel C++ 14.0 compilers** and **Linux gcc**.

According to the compiler, some additional operations must be accomplished as described in the following.

**If you want to use the BzzMath tutorial, you will need PC with Microsoft Power Point 2003 or higher.**

## You have to perform the following **general task**

Unzip the file **BzzMath7.zip** in one directory (for example in the C: root) present in your PC. This directory will be called **DIRECTORY**.

This unzip makes the following task.

- A. The subdirectory **BzzMath** is created into the directory **DIRECTORY**
- B. Five subdirectories named **lib**, **hpp**, **exe**, **Examples** and **BzzMathTutorial** are created into **DIRECTORY\BzzMath** directory
- C. The **BzzMath.lib** library is copied into **DIRECTORY\BzzMath\Lib** subdirectories, according to the selected compiler one would use
- D. All of the **.hpp** files are copied into **DIRECTORY\BzzMath\hpp** directory
- E. All of the **.exe** files are copied into the **DIRECTORY\BzzMath\exe** directory
- F. All of the tutorial **.ppt** files are copied into the **DIRECTORY\BzzMath\BzzMathTutorial** directory
- G. All of the **examples** files are copied into the **DIRECTORY\BzzMath\Examples** directory

## Windows users

1. In Microsoft Developer Studio 6.0 or later, open **Options** in the **Tools** menu option, then choose the **Directories** tab and add the directory specification **DIRECTORY\BzzMath\hpp** for include files.

2. Add **DIRECTORY\BzzMath\exe** and **DIRECTORY\BzzMath\BzzMathTutorial** in your operating system (Windows) **PATH** option: Click with the right mouse button on System Resources. Choose the Properties option. Choose the Advanced option. Choose Environment Variables. Choose the PATH option. Add the voice:

**;DIRECTORY\BzzMath\exe; DIRECTORY\BzzMath\BzzMathTutorial;**

**Please note** that when you add a new directory to the PATH environment variable you **MUST** add a ";" character (without quotes) before specifying the new directory.

After having changed the PATH Environment Variable you must restart the computer

# Use of BzzMath library 7.1

## A. Visual C++ 6.0 (32 bit)

The proper library (**DIRECTORY\BzzMath\Lib\VCPP6\BzzMath.lib**) must be added to the project. No additional operations must be accomplished using VC++ 6.0.

The program must start with the following two statements:

```
#define BZZ_COMPILER 0 // optional (default value)
#include "BzzMath.hpp"
```

## B. Visual C++ 2008 (32 bit)

Users adopting VC++ 2008, must use the proper library (**DIRECTORY\BzzMath\Lib\VC2008\BzzMath.lib**) and replace the default (DLL) run-time library. Select:

**Project/Properties/Configuration Properties/C/C++/  
Code Generation/Runtime Library**

There, if one is working in Release, the **Multi-threaded (/MT)** library must be selected; in Debug the **Multi-threaded Debug (/MTd)** must be selected.

The program must start with the following two statements:

```
#define BZZ_COMPILER 1
#include "BzzMath.hpp"
```

# Use of BzzMath library 7.1

## C. Intel 14.0 (64 bit)

Users adopting this compiler must follow what described at the point B. using the proper library (**DIRECTORY\BzzMath\Lib\INTEL\_WINDOWS\BzzMath.lib**).

The program must start with the following two statements:

```
#define BZZ_COMPILER 11
#include "BzzMath.hpp"
```

## D. Visual C++ 2010, 2013 (64 bit)

Users adopting VC++ 2010 and 2013, must use the proper library (**DIRECTORY\BzzMath\Lib\VCPPxx\BzzMath.lib**), where xx=2010 for 2010 and xx=2013 for 2013, and replace the default (DLL) run-time library. Select:

**Project/Properties/Configuration Properties/C/C++/  
Code Generation/Runtime Library**

There, if one is working in Release, the **Multi-threaded (/MT)** library must be selected; in Debug the **Multi-threaded Debug (/MTd)** must be selected.

The program must start with the following statements:

```
#define BZZ_COMPILER 2 //for C++ 2010
//#define BZZ_COMPILER 3 //for C++ 2013
#include "BzzMath.hpp"
```

## Linux users

Linux users have to develop their own makefile including the appropriate .hpp and .lib PATHS for each project. Also the proper library has to be selected:

**Compiler gcc:**

**DIRECTORY\BzzMath\Lib\Linuxgcc\BzzMath7.a**

The program must start with the following two statements:

```
#define BZZ_COMPILER 101
```

```
#include "BzzMath.hpp"
```

## openMP Windows compatibility

### A. Visual C++ 6 users

No parallel computing is allowed in BzzMath library 7.

### B. Visual C++ 2008, 2010, 2013 and Intel 14.0 users

People using these compilers must activate openMP library option for exploiting parallel computing with BzzMath library 7.1.

Select:

**Project/Properties/Configuration Properties/C/C++/Language**

**and activate openMP Support.**

## Manage openMP during computations

BzzMath library uses openMP directives for parallel computing by default when the compiler support them.

The user **who wants to personally manage openMP library must deactivate** the parallel computing within the BzzMath library to prevent any kind of parallel computing overlapping.

Inside the `main`, the first statement must be:

```
bzzOpenMP = 0;
```

Then you can start using the **BzzMathTutorial.pps** file in the **DIRECTORY\BzzMath\BzzMathTutorial** directory

# References

Buzzi-Ferraris, G., *"BzzMath: Numerical libraries in C++"*, Politecnico di Milano, [www.chem.polimi.it/homes/gbuzzi](http://www.chem.polimi.it/homes/gbuzzi)

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Buzzi-Ferraris, G., and Manenti, F., *"Fundamentals and Linear Algebra for the Chemical Engineer: Solving Numerical Problems"*, Wiley-VCH, Weinheim, March 2010

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Buzzi-Ferraris, G., and Manenti, F., *"Linear Programming for the Chemical Engineer: Solving Numerical Problems"*, Wiley-VCH, Weinheim, October 2015

# Changes from BzzMath 5 to 6

There is a single library **BzzMath.lib** and single header file **BzzMath.hpp**

All the classes and functions belonging to **BzzMath 6.0** use double precision by default (i.e., **BzzVectorDouble** is now **BzzVector**)

**Single precision** is not available anymore

**Factored** becomes **Factorized** in classes and functions belonging to **BzzMath** (i.e., **BzzFactoredLQ** is now **BzzFactorizedLQ**)

**Numerical improvements** were introduced in many classes. In addition, **new classes** were added to.

Besides **VC++ 6.0**, compatibility was extended to: **VC++ 7.0**, **VC++ 8.0**, and **VC++ 9.0** with **openMP 3.0**; **Intel 11.0** with **openMP 3.0**; and **Linux Intel 11.0** and **Linux g++** with **openMP**.

# Changes from BzzMath 6 to 7.1

**Numerical improvements** were introduced in many classes. In addition, **new classes** were added to (see references).

Compatibility of BzzMath 6.0 has been extended in 7.1 to: **VC++ 2010** and **VC++ 2013** with **64 bit** and **INTEL 14.0**.

BzzMath 7.1 is not anymore compatible for: **VC++ 2003** and **VC++ 2005**.

BzzMath 7.1 is now available for **Linux** compiler **gcc**.