Computing with Infinite and Infinitesimal Numbers in Matlab easily: The GrossoneLight Toolbox

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The introduction of the novel numeral system introduced in [1] (based on the notion of *grossone*) opens new frontiers in numerical computing, allowing to easily perform computations involving infinite and infinitesimal numbers in a *numerical* way. This work is aimed at making this powerful numeral system easily usable and accessible to the large community of Matlab users.

We have implemented (using pure Matlab code) the GrossoneLight Matlab Toolbox, a collection of classes, functions and examples that make *grossone*-based computing straightforward. The toolbox is called "light" because it introduces some limitations to the more general numeral system discussed in [1]. In particular, only numbers made of integer powers of *grossone* can be represented, together with bound on the minimum and maximum number of such powers. However, even in presence of such limitations, the implemented numeral system is powerful enough to solve basic numerical linear algebra problems.

Following the Matlab object-oriented abstraction paradigm, available in latest Matlab releases, we have been able to implement two classes: the **GrossNumber** class and the **GrossArray** class. The first class allows to represent a number made of integer *grossone* powers, where the coefficient used as multiplier for each power is a standard double-precision Matlab floating-point number. The **GrossNumber** class has been equipped with basic operations (addition, multiplication, etc) by operator overloading. This allows to operate on **GrossNumber** objects as any other Matlab scalar variable.

The **GrossArray** class has been introduced to handle operations on arrays of **GrossNumber** objects more efficiently. The speedup can be significant, especially when the code is written in a vectorized fashion and a GPGPU (General Purpose Graphics Processing Units) is available on the machine running the toolbox.

References

[1] Sergeyev Ya.D. (2009) Numerical computations and Mathematical modelling with infinite and infinitesimal numbers, *J of App Math and Comp*, Vol. 29, pp. 177-195.