Weak Rational Computing for Digital Geometry

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Abstract. Since several centuries Mathematics award the prominent position to continuous concepts and a secondary one to discrete objects and integers. On the contrary Computer Science and digital technologies lay integers and discrete structures at the heart of their concerns and recover continuous notions from them.

During the eighties some Strasbourg's mathematicians (mainly G. Reeb and J. Harthong) showed, relying on Non Standard Analysis, how integers could be substituted to real numbers in areas like Analysis and Geometry.

Even if Strasbourg's NSA researchers were not, at first, motivated by relationships between Mathematics and Computer Science, they soon realized the interest of this issue and started some work in that direction, mainly on the use of *all integers methods* to integrate differential equations.

It was only from 1987 that convergence with Digital Geometry arose (A. Troesch, J.-P. Reveillès) resulting in original definitions for discrete objects (lines, planes, circles...)

Work independently done since that time by digital geometers produced many results but, also, the need for new tools as one to treat *multiscale digital objects*.

We will briefly explain why mathematicians can be interested in Non Standard Analysis and some of the consequences this had in Strasbourg's mathematics department, mainly Harthong's Moir theory and Reeb's integration of equation $y' = y$ by an *all integer* method.

This last one, called *Weak Rational Computing*, is a kind of abstract *Multiscale System* which will be detailed with the help of simple linear and non linear differential equations and iteration systems applied to geometric entities.