Evolution

Transcomputation is any computation that uses a transarithmetic.

Transreal arithmetic uses a subset of the algorithms of real arithmetic to deliver a superset of real arithmetic. This superset is total: every arithmetical operation can be applied to any numbers with the result being a number.

Transcomplex arithmetic is a total superset of complex arithmetic and is obtained by using transreal arithmetic in a special geometrical construction. See right.

- Replace minus zero and all NaNs in IEEE 754 floating-point arithmetic with transreal numbers, thereby doubling the range of real numbers encoded by the floating-point bits or else halving the threshold at which floating-point numbers underflow to denormal numbers near zero
- Transcomplex numbers are total. They already contain the point at infinity and the line at infinity which are ordinarily used to compactify complex spaces. They also contain points that are ordinarily omitted from complex analysis so any round-off error still produces a validly analyzed case
- Totality guarantees that if a program compiles then it has no logical run-time errors. This improves reliability and simplifies verification
- The transreal-number line looks like a simple evolution of the real and extended-real number lines:

\[Q = r_0 = \frac{r}{f_i}n\]

Revolution

The totality of transreal and transcomplex computations means that:

- In-line programs can be completely pipelined so that a program completes execution every clock tick
- A molecular dynamics program, that is resident in memory, shares data about the previous iteration with \(n\) molecules in the current iteration so \(n\) pairwise molecular updates can be completed every clock tick
- Hardware is simplified to the extent that we expect to manufacture a 1 PFLOP computer, with a power budget of 10 kW, at a price of $5 m
- All previously described complex-number spaces map onto the transcomplex-number space but this has parts that are new to mathematics: