Transreal Computing
Research and Portfolio-Company Showcase
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Dedication

This presentation is dedicated to the USS Yorktown which was stranded for 2 hours 40 minutes when a division-by-zero error crashed its entire network of computers, causing its engines to stop.
Outline

- Who am I, and where am I from?

- Transreal arithmetic – or how to divide by zero and do infinitely many “impossible” things.

- How to make computers that calculate “impossibly” fast.

- Commercial potential.

- What am I going to do next?

- Conclusion.
Who am I?

• A psychology graduate who worked in Electrical and Electronic Engineering departments at Sussex University and Plymouth Polytechnic.

I wrote one program that reduced the time to compute a spacetime convolution of MRI images from 9 days to 3 seconds.

And another one that could recognise a double decker bus in one second.

• Reading University made me a lecturer and then gave me a doctorate for developing a canonical description of the perspective transformations in whole numbered dimensions.
Where am I from?

The School of Systems Engineering:

- 40 Academic Staff.
- 55 Research, Technical, and Administrative Staff.
- 120 Postgraduate Students.
- 650 Undergraduate Students.
- Offers degrees in Computing, Cybernetics, Electronics, and Artificial Intelligence.
Where am I from?

Research groups:

• Informatics Research Centre (IRC).

• Reading E-Science Centre (RESC).

• Infra-red Multilayer Filters (IMF).

• Advanced Computing and Emerging Technologies (ACET).
What’s wrong with arithmetic?

It doesn’t work:

• Can’t find the tangent of a right angle ($\infty$).

• Can’t find the logarithm of zero ($-\infty$).

• Can’t find zero to the power of zero ($\Phi$).

• Can’t explain how computers work (NaN).

• Mathematical arithmetic does not describe the arithmetic that people use in their daily lives as programmers or users of computer systems:

• Mathematical arithmetic is sociologically invalid.
What’s wrong with computers?

- NaN, Inf, and –Inf are not numbers.

- NaN ≠ NaN, but equals means $x = x$ for all $x$ so computer arithmetic is invalid.
Transreal Arithmetic

- I developed transreal arithmetic over the last ten years.
- For the first time in 3,000 years it makes every fraction \( n/d \) a number.
- For the first time in 1,200 years it handles division by zero \textit{arithmetically}.
- Division by zero has been possible in calculus since Newton and Leibniz 300 years ago.
- Division by zero has been possible in algebra since Hamilton 200 years ago.
Transreal Arithmetic

- Transreal numbers are defined by a number line:

\[ \Phi \quad -\infty \quad 0 \quad \infty \]
Transreal Arithmetic

All fractions (including numbers over zero) are transreal numbers:

For all positive numbers $k$:

- $\infty = \frac{k}{0}$ and in least terms $\infty = \frac{1}{0}$

- $\Phi = \frac{0}{0}$ is already in its least terms

- $-\infty = \frac{-k}{0}$ and in least terms $-\infty = \frac{-1}{0}$
Transreal Arithmetic

There are just three special rules in transreal arithmetic.

- Numbers are always reduced to least terms as soon as they are produced.

\[
\frac{a}{c} + \frac{b}{c} = \frac{a + b}{c}
\]

\[
\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}
\]

Q. But you already know these rules, so why can’t you divide by zero?
Transreal Arithmetic

A. Because school teachers and university lecturers do not teach arithmetic so that it works for all combinations of numbers.

- I can teach you transreal arithmetic in ten minutes.
- I am willing to help school teachers develop a curriculum for transreal arithmetic.
- I teach my own students transreal arithmetic.
- Other lecturers are free to follow my lead.
Transreal Arithmetic

- This year I axiomatised transreal arithmetic.

- Essex University gave a computer proof that the axiomatisation is correct.

- Cambridge University, “Can not find any fault in the machine proof and believe it is correct.”
Transreal Arithmetic

All of the standard counter-proofs which attempt to demonstrate that division-by-zero is impossible in arithmetic are:

• Falsified by the computer proof of the consistency of transreal arithmetic.

• Explicitly shown to be erroneous by my hand proofs.

• I will defeat any counter proof you care to present me with.
Transreal Arithmetic

For the last 1,200 years no one has been able to evaluate zero to the power of zero arithmetically.

Q. How hard can it be?

A. Key Stage 4.
Transreal Arithmetic

\[ 0^0 = 0^{(1-1)} \]
\[ = 0^1 \times 0^{-1} \]
\[ = \left(\frac{0}{1}\right)^1 \times \left(\frac{0}{1}\right)^{-1} \]
\[ = \frac{0}{1} \times \frac{1}{0} \]
\[ = 0 \]
\[ = \Phi \]
Fast Computers

Having an arithmetic that works on all combinations of numbers means I can build computers with:

- No circuitry for handling arithmetical exceptions, because there are no arithmetical exceptions.
- No circuitry to choose instructions because there is only one instruction.
- No circuitry to decode an instruction because an instruction is itself.

This means my computers will run orders of magnitude faster than today’s computers.
Commercial Opportunity

How much would you pay:

- To know that the engine in your ship, car, aeroplane, or heart pacemaker won’t just stop dead.

- To know that your Government’s computer controlled military hardware won’t just stop or misfire.
Commercial Opportunity

How much would you pay for a computer that runs:

- 10 times faster than a PC?
- 100 times faster than a PC?
- 1,000 times faster than a PC?
- 10,000 times faster than a PC?
- 100,000 times faster than a PC?
- 1,000,000 times faster than a PC?
- 10,000,000 times faster than a PC?
What Next?

- Build a transreal computer.

- Implement an Abstract Syntax-Tree (AST) so that users can display a program in any language.

- Implement software for Computational Fluid Dynamics (CFD).

- Derive Maxwell’s equations and classical gravitation in transreal numbers so they have no naked singularities (infinities affecting a neighbourhood of space).

- Collaborate with anyone who wants to unify Quantum Electro-Dynamics (QED) with gravitation.
Conclusion

• Standard arithmetic is invalid.

• Transreal arithmetic is just standard arithmetic with standard arithmetical algorithms applied correctly.

• I will help you develop a curriculum for transreal arithmetic if you want me to.

• I will help you unify QED and gravitation if you want me to.

• I will build a transreal supercomputer.

• I will defeat any counter-proof of division by zero you care to present me with.