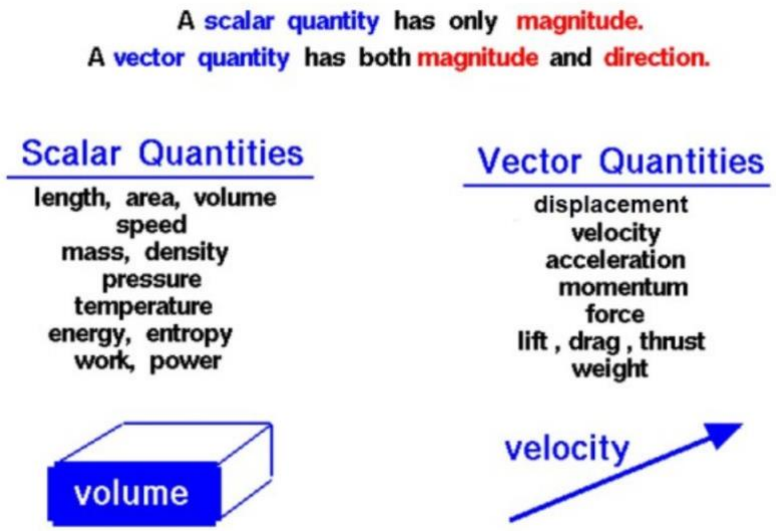
Beyond Magnitude and Direction – Unspoken Hypotheses of Scalar and Vector Theory by Jack Pullinger

Introduction

Scalars are physical quantities with a magnitude but no direction. Vectors are their directional counterpart. Tensor is the umbrella term they both fall under but is typically a higher order measurement (I will only mention these briefly).

These are undisputed facts, on every physical and mathematical level. It makes sense. It is elegant and intuitive. You cannot perform a physical measurement of a variable without said variable having an associated size. In other words, it is impossible to measure a standalone direction.

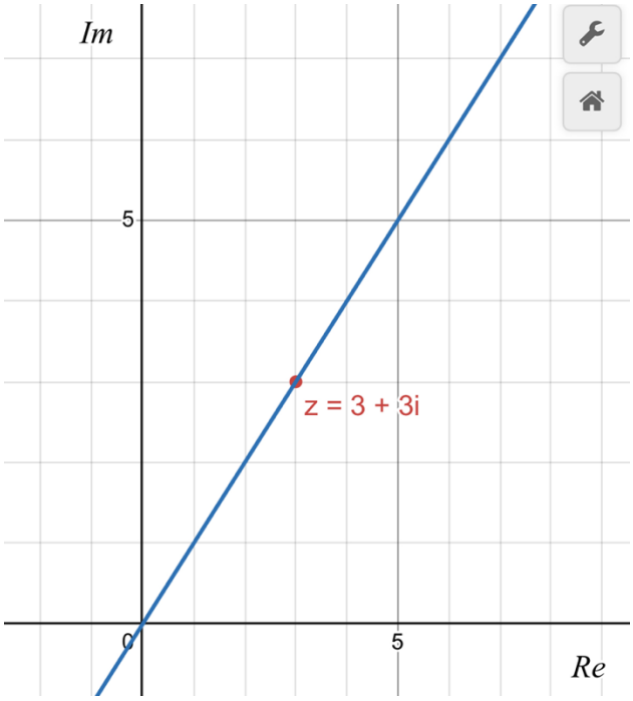
To make it sufficiently clear, the hypotheticals I will be exploring are not conducive to the laws of mathematics and physics and never will be. Moreover, I shall be adopting a similar format for each hypothesis, where I begin by making specific, surface level tweaks to vector and scalar theory, before elaborating and exploring how it may permanently alter the theoretical framework of mathematics. I will incrementally uncover the irreversible impacts on human function these alterations would entail. From now onwards, the inherent rigidity of scalar and vector quantities is no more, in place of a far hazier numerical system.



Hypothesis 1: Imaginary numbers take precedence over real numbers

In the oftentimes convoluted and opaque field of advanced mathematics, it is comparatively common knowledge that a 2D vector in the form (a, b) is a list of 2 scalars in the x-y plane and may be alternatively represented as a coordinate in relation to a fixed origin.

Imaginary numbers are far less straightforward. They are primarily encountered by taking the square root of a negative number, with the letter i later universalised as standard notation for the square root of -1, by Leonhard Euler. For centuries prior, solving equations yielding imaginary solutions was dismissed as fanciful. It was merely unexplained hitch in an otherwise coherent field of numerical function, as far as mathematicians were concerned.



If Pythagoras' Theorem were also directly applicable to imaginary numbers, the real magnitude of a directional vector including real and imaginary components, could spontaneously disappear into oblivion. For instance, assigning points lying 3 and 3i arbitrary units away from a fixed reference point on a fixed plane (displayed using a 2D argand diagram/complex linear graph), the respective directional vectors acting perpendicular to one another. By Pythagoras, the shortest possible between these coordinates would equal the square root of 3 squared plus 3i squared. As we know, i squared is an identity for -1, hence 3i all squared equals -9. It then follows that 9 – 9 all square rooted equals 0, or a null vector in the form (0, 0). If the 1:1 ratio between these perpendicular distances from the origin were to be maintained over astronomical distances, then it would not be a ridiculous suggestion that you could be located on

Earth and Mars simultaneously. The fusion of these planets would also become a distinct possibility.

$$||\mathbf{v}|| = \sqrt{3^2 + (3i)^2}$$

$$||\mathbf{v}|| = \sqrt{9 + (9 \cdot -1)}$$

$$||\mathbf{v}|| = \sqrt{9 - 9}$$

$$||\mathbf{v}|| = \sqrt{0}$$

$$||\mathbf{v}|| = 0$$

Subsequently, as the Earth continued rotating, it would undergo periodic incineration, due to the sun lying on the same axis at particular instants. Conversely, under these conditions, direction would not exist either. The most unlikely paradox would suddenly come to fruition: zero is multifaceted. Hence, 0! ≠ 1 under these conditions.

Using the Pythagorean blur of real and imaginary components, the minimum distance between an atom at a fixed reference point and an atom on a star that is light years away, is conditionally negligible. Therefore, there is no tangible obstacle to the strong nuclear force collapsing the universe into a single, cosmic nucleus. This crunching mechanism would indiscriminately occur regardless of gravity's existence or otherwise because the latter is comfortably the weakest fundamental force. Means of reversing this catastrophic destruction would swiftly dematerialise.

Hypothesis 2: Vectorisation of inertial mass

$$\begin{bmatrix} F_x \\ F_y \\ F_z \end{bmatrix} = \begin{bmatrix} m_x & 0 & 0 \\ 0 & m_y & 0 \\ 0 & 0 & m_z \end{bmatrix} \begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix}$$

Mass is a scalar quantity and the constant affirming the directly proportional relationship between the variable resultant force and acceleration vectors across all environments, transcribing the F = ma equation for Newton's Second Law of Motion. The direction of the resultant force is therefore consistent with the direction of the rate of change of velocity. If mass were not directionless, this relationship would be jeopardised, leading to irreversible consequences.

$$E = mc^2$$

Even if mass were to become a 2D vector only, with no k component, energy would lose its directional independence in an instant and shoehorn into an unprecedented bilinear

form. Furthermore, energy and mass are interchangeable and directly proportional quantities, as per Einstein's mass-energy equivalence formula. Moving objects would immediately acquire the ability to gain kinetic energy through deceleration. Assuming that work done over a positive linear displacement still depends on resultant force, it's numerical value would change from negative to positive when a negative acceleration is coupled with a negative mass. Since work done and energy are closely related, efficiency of energy transfers could far exceed 100%, with explosive energy outputs putting the public's safety at risk. The opposite is also true on a similarly gigantic scale where unprecedented energy shortages under specific uncontrollable circumstances could cause global blackouts.

$$K = \frac{1}{2}\mathbf{v}^T\mathbf{M}\mathbf{v} = \frac{1}{2}\sum_{i,j} M_{ij}v^i v^j \qquad E = \frac{1}{2}ke^2$$

Energy is a scalar quantity, since any velocity value squared invariably yields a positive energy value, due to mass' positive value in the kinetic energy formula. A mass comprised of i and j components would render the conservation of energy principle an impossibility, since some energy stores would become directional and others would not. For example, elastic potential energy relies solely on a specific material and to what extent it has been stretched. Mass is not applicable to this form of energy, so if the i and j components of mass are unequal, inconsistent amounts of kinetic energy would be transferable, since the maximum value would be dictated by mass direction.

Elsewhere, Einstein's law of General Relativity fundamentally hinges on the presumption that mass is a scalar. Otherwise, space and time would segregate themselves from one another, with the new hyperbolic nature of mass dismantling the associated equation's underlying assumptions about matter. T, the stress-energy tensor – a higher order of measurement which can be visualised in matrix form and linearly relates vector spaces – would automatically promote itself to an even higher-ranked projection (a rank-2 tensor). This would, in turn, leave the stress-energy tensor highly asymmetric; the two sides of the equation unable to balance under any circumstance. Since G, the Universal Gravitational Constant, is a scalar that permeates the entirety of outer space, mass vectorisation would require a transition into a rank-4 tensor or a highly complex matrix, in order to map the directional mass to the unchanged curvature of space. Effectively, G would become anisotropic like an electrical diode, and gravity's strength would entirely depend on a particle's orientation.

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

In practice, the Earth would once again self-destruct, but far less peacefully: If the G tensor is no longer perfectly aligned, the North Pole might attract to the Sun more than the South Pole does, exerting a torque so great that its spherical shape is compressed into an ellipsoid, ripping the solid inner core from its equilibrium position, and catapulting it into the mantle, like a cannonball. Ensuing volcanic eruptions and global extinction would supersede the oblate spheroid's ability to withstand its elastic limit. Ribbons of glowing debris would illuminate the sky until the whole planet eventually shreds into confetti.

Hypothesis 3: Angular Time Decays

In a similar vein to mass, time is one of the 7 fundamental quantities of the universe. From the outset, it does not seem unreasonable to suggest that even the tiniest alteration would incur a disproportionately momentous response from the universe. In large part, this is down to its prominence in terms of common rates of change, namely power (of energy), current (of charge), velocity (of displacement) and acceleration (of velocity). The latter two quantities are vectors and the first two are scalars.

If time were not necessarily directional like a typical vector, rather an angular hybrid of sorts, this would send shockwaves through the time singularity concept. Simply put, time would become cyclic and modular, causing it to rotate and polarise, resulting in an imaginary mass or energy state that does not exist in our current four-vector model of the universe. Time would adopt wave-like behaviour: one vector of time could interfere with another, either destructively, in which the Earth stalls and can no longer orbit the sun, or constructively, bringing about an uncontrollable surge of progression.

Another bizarre consequence of effectively polarising time is that for every full cycle that passes (2 pi radians), the proceedings at this instant would be projected to the beginning of the subsequent time cycle, layering on top of one another, with no immediate resistive force, as such, to oppose or stifle this. Painful memories would linger, reinforcing and directly influencing present actions. The philosophical idea that time is the greatest healer would no longer withstand the pressure of cumulative despair and entrapment. The only solution remaining would be to somehow shift location to a 'phase buffer' in which the interference is destructive.

This clock dilation effect can be modelled using modulus-argument form, far removed from the current system of treating t as an exclusively scalar variable. 0, or any even integer multiple of pi radians would represent the same complex number, provided the modulus stays constant. Bearing in mind that the modulus continuously increases, the

hologram of earlier events would instead fade exponentially until it asymptotically decays towards 0.

$$T = r(\cos\theta + i\sin\theta)$$

Accordingly, a geometric function of Euler's number (≈2.718) could be used to demonstrate this angular decay. If a past event were to be recorded as a signal (S) over the hybrid of time (T), this function could be equated to the initial intensity of the event (A), multiplied by Euler's number to the power of the product a negative constant (lambda) and the scalar distance (r), multiplied by the cosine of the constant angular component of 2 pi radians (theta), with w acting as a scalar integer multiplier for theta.

$$S(T) = Ae^{-\lambda r}\cos(\omega\theta)$$

This translucent congestion of events would devalue the preciousness of memory, since it would become a readily available echo of information that fades, yet never truly ends. The ability to distinguish between feelings and memory would spiral and the linear logic of cause and effect would be the very catalyst for the decay of progression. By trying to hold onto the moment, you could inadvertently linearise the circle and catalyse time's death, in a literal sense.

On a far more destructive scale, the fourth dimension knitting the universe together would mathematically dissolve, when the cosine value reaches zero. Without this, the universe would flatten out into a state of zero temporal thickness, preventing gravity and electromagnetic forces from acting, since the medium is incapable of interacting with it. When the exponential decay shrinks time below what the Planck constant allows (≈5.4x10^-44 seconds), the universe would experience a quantisation crisis of mathematical irrelevance, the simulation of reality destined to crash. As time tends towards 0, the energy needed to escape the stasis increases exponentially, until it becomes an insurmountable bridge to cross. Unlike the first two scenarios, the universe would not shred or collapse violently; it would peacefully leave behind a static spacial skeleton of nothingness.

Conclusion

Not one of these hypotheses are objectively possible because the laws of mathematics simply do not allow them to occur. Mathematics controls the universe and the universe dictates the mathematics. However, it is still important to deeply understand the why, not just the what. Why do scalars and vectors exist? Why are hybrids an impossibility? What would happen if mathematics were a more subjective language of context and preventative action? It is still unclear whether flexibility and adaptability to the universe

could ever arise or if mathematical truth and order forcibly rectify universal disruption, to restore the status quo. Mysteries of this magnitude may never be solved, direction dependent or otherwise.

References

1. NASA's scalar and vector diagram: https://www.grc.nasa.gov/www/k-12/rocket/vectors.html
2. Desmos argand diagram/complex linear graph hybrid: https://www.desmos.com/calculator