A new look at the Fitzhugh-Nagumo method in MacTaggart A-series simulation, together with the use of solitons or chaos theory

In our dynamical systems models (1) for the waking and sleeping brain, we used Berkeley Madonna for the simulations and after exploring a very wide number of possibilities and many parameter values. The Fitzhugh-Nagumo (FHN) model is discussed briefly in Section E of that paper. The conclusion was come to in that paper that *"In common with results for many cases where modelling is made slightly more complicated but requires more parameters, so far (the FHN) does not seem to have really paid off at this level of model making. It might be a way forward at a later date however."* However some quite satisfactory results were obtained with slightly simpler models, such as the one referred to as N003b.

I had in mind numerous previous instances such as the great initial effectiveness of the Kuramoto model, its obvious applicability to many systems and yet the extremely difficult process of refining it much further in specific cases. The Kuramoto model seems to have been useful in a general way in areas as varied as descriptions of neural processes and the London Millennium Bridge.

Solitons

Since we are working in reference (1) in the region of models like the FHN model it seemed reasonable to consider whether any alternative or sufficiently differing brain models might produce better results. The Soliton Model (2) in neuroscience is justified as follows: *"The model starts with the observation that cell membranes always have a freezing point (the temperature below which the consistency changes from fluid to gel-like) only slightly below the organism's body temperature, and this allows for the propagation of solitons. It has been known for several decades that an action potential travelling along a neuron results in a slight increase in temperature followed by a decrease in temperature. The decrease is not explained by the Hodgkin-Huxley model (electrical charges travelling through a resistor always produce heat), but travelling solitons do not lose energy in this way and the observed temperature profile is consistent with the Soliton model. Further, it has been observed that a signal travelling along a neuron results in a slight local thickening of the membrane and a force acting outwards; this effect is not explained by the Hodgkin-Huxley model but is clearly consistent with the Soliton model. It is undeniable that an electrical signal can be observed when an action potential propagates along a neuron. The Soliton model explains this as follows: the travelling soliton locally changes density and thickness of the membrane, and since the membrane contains many charged and polar substances, this will result in an electrical effect, akin to piezoelectricity."*

Now this is a new model and differs in very significant ways from the FHN model and similar models, and whilst it is claimed to have many advantages, such as in an understanding of the Meyer-Overton observation, this attempt to explain nerve transmission by sound impulses rather than simply electrical impulses certainly has not replaced the conventional model. At the same time, the model we were trying to use is basically an interpretation of the A series using B series mathematics. It is only a model not an elixir, and the position is very like that of the traditional John Godfrey Saxe description of the blind man describing an elephant - it will not be right in every detail. David Corfield's general suggestion (3) involving the use of vector solitons, as has been already used in somewhat similar cases, could well be a further way forward.

And this is not a walk in complete darkness - consciousness has frequently been described as an emergent phenomenon in a collection of neurons, as indeed have matter wave solitons and optical solitons been described as emergent and placed in the same category. Filamentation is a

related phenomenon as exemplified by meandering rivers and lightning bolts.

And, just as consciousness can clearly be said to presumably relate to the P=NP? problem, in 2002 I had considered looking at soliton theory and the Backlund transformation, in the hope that Mielnik's idea could be extended.

Further, it has even been suggested by Hameroff and Penrose (4), that quantum computation in the brain works by solitons. Both Hameroff and Penrose have produced many interesting ideas, though this one has encountered much opposition, so it is mentioned here although we do not propose to use it at this time.

So as distinct from simple philosophical argumentation and questioning - still important tools - we can do the calculations in Berkeley Madonna, without - and this is a key and important point - losing important philosophical stringency in the way that seemingly began in quantum physics on the introduction of the Copenhagen Interpretation and then got to the point where a dog can now seem to be able to understand quantum mechanics better than a human can.

But we already have the added problem in X-phi (experimental philosophy) of a trend to mathematical oversimplification and a rush to philosophical relativism almost like a Hollywood star might run to a Dr. Feelgood with dire consequences, so a lot more work needs to be done steadily and carefully in X-phi also.

I do not yet know if the soliton approximation will help, but it is a matter of trying it for various cases without seeking a mental Theory of Everything, and solitons could be said to be more physically realistic than FHN though for the moment model N003b is still the top priority.

Chaos Theory

Another important model is described in a video (5). This can possibly correspond to the sandpile effect we have been mentioning in this blog for some time now.

The effect is now discussed in the eminent and well recognised Conscious Entities blog (6), which particularly states "One claim not made in the article, but one which could well be made, is that all this might account for the sensation of free will."

I have to agree with that possibility and reference (1) of course remains open to that effect and indeed briefly discusses it as the "butterfly effect". You would expect a chaos effect to arise in any model which allows for the so-called 'unconscious mind' as its existence is what might be called a 'brute fact' as clearly the conscious mind is not capable at this time of fathoming the hidden realms of day to day consciousness. Hence there is scope in our present models for both dreams and chaos. Furthermore there is certainly no immediate requirement for 'pure chance' or 'god' or some sort of 'blind watchmaker' or indeed a 'homunculus', because of where our theory has come from.

Conclusions

So the next step is possibly to consider the recent work of Banks (7), which may have produced a live psychological experiment, not involving brain tampering, which provides a clear physical example of the Libet and Haynes effects.

Provided we realise that any instances of our brain model are merely partial mappings of the A series to the B series, there should be no conflict with free will concepts, and further progress may be becoming clearer.

References

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