WEB-EM-05 Abstracts and Feedback

Name: Henry Franks

Library Card Number: 0503985

Provisional Title: An investigation into the tuition of music theory using EM

Abstract: Learning a musical instrument has been shown to stimulate creative thought and develop areas of the brain crucial to other activities, such as co-ordination and spatial awareness. Yet the theory of music is steeped in dense, historical terms and counter-intuitive notions, which can make it intimidating for the newcomer to learn. It is inherently a subject that is hard to articulate, and the limitations of language in describing tones, timbres and musical effects can slow progress. Yet by gaining an all-encompassing understanding of the basic relationships between various components of musical theory, the trainee musician will see vast improvements in compositional ability. While the majority of musical tuition is in conjunction with an instrument, it can take time for the ear to develop an ability to accurately discern notes, and even longer for more complex harmonic structures such as chords, which can hamper the understanding of the theoretical concepts at work. By creating an open-ended, visual environment, EM techniques can be used to bypass these problems. By the time the ear is sufficiently trained, the user can already hope to have a practical understanding of basic theory.

Empirical Modelling techniques lend themselves well to the themes of educational technology. Constructivist learning is a technique easily enabled by empirical modelling. By creating a tool to visualise the interdependencies of basic music theory and by exploring these relationships, the user can learn far quicker than by a teacher simply attempting to tell the student these ideas.

This paper will present and discuss how a visualisation tool for basic music theory can be used to assist the tuition of music theory and provide a clear visualisation of music theoretical relationships. The effect of this tool will be placed in the context of education in general and the application of EM to educational technology.

Model description: The modelling study for this paper will consist of the development in tkeden of a tool to visualise how scales, chords and notes relate to each other. By interacting with the tool, the user can change which scales and chords are displayed, and the colouring of the visualisation will attempt to show the dischordancy (or not) of the related notes. By exploring this world, the user can then visualise more easily the dependence and effects notes and chords have with each other. These relationships are often hard to articulate, and so by showing them more visually, when the user analyses music they will be able to recognise them more easily.

References:

- 1) Meurig Beynon. Mathematics and Music - Models and Morals. In Conference Proceedings, Bridges London: Mathematical Connections in Art, Music, and Science (eds. Sarhangi and Sharp), Tarquin Books, 2006, 437-444. [094]
- 2) Meurig Beynon. Computing technology for learning - in need of a radical new conception. In Journal of Educational Technology & Society, 10 (1), 94-106. [096]

- 3) W.M.Beynon. Empirical Modelling for Educational Technology. Proc. Cognitive Technology '97, University of Aizu, Japan, IEEE, 54-68, 1997. [047]
- 4) Unknown Author, Synesthesia for all ? crafting a colour model of Schuberts Erlkonig, The Third Warwick Empirical Modelling Bulletin (WEB-EM-03)
- 5) Unknown Author, An Educational Model for Newtonian Mechanics, The Second Warwick Empirical Modelling Bulletin (WEB-EM-02)
- 6) Unknown Author, An empirical modelling approach to educational technology in learning about business, The Second Warwick Empirical Modelling Bulletin (WEB-EM-02)

Weighting: Paper - 70/Model - 30 (Paper not exceed 7 pages)

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This is a very promising topic for a study. There have been examples of related investigations before - they include the model musicWai2000 and a more recent 3rd year project about learning the guitar supervised by SBR. I'm not sure that I understand the nature of your study fully and it would be a good idea to find a title that describes your theme more precisely. Your first paragraph suggests aural training, but the emphasis is thereafter on visualisation. Obviously visualisation is better suited to what is already supported by tkeden. (I don't know if you propose to generate sound, but I can supply more resources relating to that requirement if you need them.) You may find it useful to look at the 'Sudoku Experience' workshops (at http://www.dcs.warwick.ac.uk /~wmb/sudokuExperience/workshops/) for discussion of associating colours with numbers (the specific theme of workshop 2C I think). There is a model of a keyboard made by Karl King that may also be of interest. I would be glad to discuss this topic with you further.

Small points: I don't think there is a word 'dischordancy', but probably is one 'discordancy'. It's important to use 'Empirical Modelling' as this distinguishes it from 'empirical modelling' - it's a pity this is necessary, but it's otherwise misleading. I'm not sure that the 70:30 proposed split is the msot appropriate. There should be enough meat in the model-building to justify a higher proportion of the mark, whilst your abstract for the paper doesn't yet indicate what significant (and potentially novel) points you are going to make about EM. Note that there are other references about from 2) and 3) that you might wish to consult if you want to develop the agenda for the paper (see the references for Lecture 20 on the CS405 webpage, and perhaps other references such as EM paper 100 for the theme of constructivism, which might supply an useful peripheral point of focus for your study).

Name: Sanket Shah

Library Card Number: 0505829

Provisional Title: Furthering the Application of Empirical Modelling in Teaching Biology

Abstract: This paper considers the use of Empirical Modelling in teaching biology to students (educational technology). It extends the ideas proposed on a paper listed in the 1st EM bulletin on applications of EM in teaching Human Biology, as it proposes other areas of biology equally making use of EM modelling in teaching.

An EM model of either the human kidneys/or a plant body function will be constructed and used throughout the study.

- -Introduction
- -EM concepts connected to more than just Human Biology
- -Key Features of the model
- -Learning in developing the model
- -Use in its use by students (learning by using the model)
- -Potential for extension and binding to other biology EM models.
- -Conclusions

Model description:

KIDNEY: Will include observables as being 'blood content', number of nephrons in the kidney, possible disease types affecting kidneys directly, the hormone levels released by the kidneys and the general performance of the kidney in filtering the blood.

dependencies - much is dependent on the blood content and number of nephrons especially kidney performance

agents - possibly linking some of these depndencies together. There is scope here for the kidney model being combined with the lung model created in WEB-EM-01 paper via the 'blood content'.

Also, the hormones created and effect of diseases on the kidney performance could affect future organ models such as the heart.

- - effect of diabetes and high blood pressure
- - can lead to chronic kidney disease (slow process)
- - can lead to heart attacks which could be used as as a future dependency on a new heart model.

References:

- WEB-EM-01 paper, 'Empirical Modelling and its Application in Teaching Biology'.
- Biology A-level textbooks for information on dependencies within the kidneys and on other areas of biology teaching (plant anatomy)

Weighting: Paper - 70/Model - 30 (Paper not exceed 7 pages)

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This title and abstract is still in a fairly sketchy state. You have written rather more informatively about the model rather than the paper, and this is not entirely consistent with the proposed 70:30 split. You may also find the model-building technically demanding enough to justify a larger weighting, especially if you prototype any extensions. Your outline for the paper doesn't entirely make sense to me: what is meant by 'Use in its use by students'? Bear in mind that you are allowed to supply documentation for your model independently of your paper, and the paper should be quite different from a write up of the model-building. The key question to ask about your paper is: What principles of EM does it illustrate? and ideally you want to add something to what has been done before either through new thinking or through novel model-building.

The idea of model combination is good. I would also consider whether you can explore dependencies that might link kidney pathology to patient symptoms, and maybe also consider modes of kidney damage and failure. This would go beyond the previous lung model in a significant way. It's not quite clear whether you intend to maintain a single focus (on modelling the kidney) or introduce other topics (such as plant anatomy), but I'd probably recommend sticking to a single topic. There are incidentally some amazing plant models in the work of Prusinkiewicz - a professor in graphics at Calgary, but these are more mathematical and algorithmically inspired. Perhaps your references should include medical as well as biological sources. (I don't know what exists by way of models for medical students, but it would be good to consider this issue also if possible.)

Name: Joel Gascoigne

Library Card Number: 0526508

Provisional Title: Modelling Self-Adjusting Environmental Heavy Goods Vehicle Reversing Alarms

Abstract: The Health and Safety Executive (HSE) estimates that 25% of all work-related road deaths are caused by reversing vehicles. This paper will analyse and empirically model techniques by which vehicle reversing alarms can be "smarter". Beneficiaries of the techniques include the driver, pedestrians and nearby residents. An original empirical model will be created in order to illustrate how empirical modelling may be used in this context to educate users as to how the system and various techniques work.

One such reversing alarm technique is to sense the ambient noise level at specified time intervals and adjust the volume of the alarm accordingly. This ensures firstly that the alarm is always heard, whether the vehicle is in a noisy environment such as a quarry or a quieter environment such as a work yard in a rural location. The alarm will always be adjusted to be above a certain threshold of the sampled ambient noise level in the area. Secondly, this means that the reverse alarm is ?environmental?, meaning that there is reduced noise pollution because the alarm is not at a fixed noise level which could be much higher than ambient noise levels in the area and therefore more clearly audible at nearby residential properties.

Another technique is to detect whether there is actually an obstructing object behind the

vehicle. This means that the alarm only sounds when it is required: again minimising noise pollution. An extension of this technique further is to sound the alarm in three stages. The first warning is a slow bleep, the second is an urgent bleeping and the final stage is a constant tone. The benefit of this technique is increased feedback, both for the driver and for any obstructing pedestrians or vehicles. Yet another further extension of this would be to vary the volume of the alarm depending on the distance away the object is from the heavy goods vehicle.

A third technique is to use broadband sound which is instantly and unambiguously locatable. Sound used in traditional narrowband alarms bounces off reflective surfaces. This could give false directional clues and potentially lead to personal injuries. Broadband sound (e.g. white noise) is also more environmentally friendly because narrow band alarms produce a tonal noise which is much more annoying to nearby residents. The use of broadband sound could result in an extension of the volume adjustment technique described above where the ambient noise level is sampled in frequency bands and the sound spectrum of the alarm is adjusted accordingly.

Two other possible extensions for the model would be to have a 'fail-safe' mechanism to fall back to a very simple reversing alarm if there are any failures within the system, and to use frequency bands in order to not only review the overall volume of the background sound but the individual frequency bands of the noise, in order to output an alarm sound which has volume slightly higher for all frequency bands.

The context described allows for effective use of empirical modelling principles such as observation, dependency and agency.

Model description: Reversing alarms are alarms which sound when a vehicle is reversing. "Smart" reversing alarms do a bit more to benefit different users and be more environmental.

The first technique would be modelled by having a background noise level which can be changed by an agent, which would typically be a person. Changing the background noise level would affect the output volume of the alarm. Both sound levels will be visible in the form of longitudinal waves, for example like a sine wave. The volume of the alarm will always be adjusting and be 5-10 dB higher than the sampled background noise level, which will be monitored once a second by the alarm mechanism.

For the second technique, there will be a sensor mechanism which can sense when an object is behind the heavy goods vehicle. There will be a display which shows the heavy goods vehicle and some way for an agent to move an object behind the heavy goods vehicle. It will be visible in the sound output for the reversing alarm that the alarm is going through the three stages mentioned. In addition to this, the volume will be seen to increase when the object is closer.

The third technique would be shown in the output by having frequency bands and showing that the output does not have a significant peak in a band and be low in other bands, as would be the case with traditional narrowband alarm systems.

The possible further extension of a fail-safe mechanism could be show by having a button that an agent could use to trigger an error. The system would then fall back into its simple

alarm system.

References:

- http://empublic.dcs.warwick.ac.uk/projects/roadtrafficStein2005/
- http://empublic.dcs.warwick.ac.uk/projects/trafficlightMendis1997/
- http://empublic.dcs.warwick.ac.uk/projects/liftHarfield2005/
- http://empublic.dcs.warwick.ac.uk/projects/carhistoryWood1995/
- http://empublic.dcs.warwick.ac.uk/projects/carparkingsimMcHale2003/
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Weighting: Paper - 50/Model - 50 (Paper not exceed 5 pages)

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This is an excellent conception for paper and model. The title is already well-focused, and you have identified the potential scope in an appropriate open-ended and imaginative way. My main question concerns your intentions where modelling sound is concerned. You could be expecting to generate sounds - in which case I'm not sure that EDEN will provide the speed of response you need to model sound in the way you have envisaged for your application, or you may be intending to make graphical representations of waveforms (for which again EDEN is not ideally suited without some extension - though graph-drawing extensions have been introduced in some models and I can supply some pointers). This leaves some concern about whether you have fully appreciated the technical difficulties of dealing with integrating sound with EDEN (a topic for which you'd get credit in any event, even if you can't solve all the problems!). You might just wish to look at Nick Pope's DOSTE API in the connection. Your references for the paper should include some resources relating to the engineering research field of noise reduction, hopefully accessible to a non-specialist reader! The actual models cited as references don't address the issue of sound at all, and tend to be focused on the 'vehicle' aspect of the modelling, which is probably not too relevant.

Small points: You should use "Empirical Modelling" not "empirical modelling" (see previous comments). The term "empirical model" is tempting, but not one I like (for similar reasons). It's odd to speak of an "EM model," but I think it's more appropriate. You also have options of terms like "EM artefact" and "EM construal" (there's some discussion of these in Lecture 20 in the website).

Name: Alan Hazelden

Library Card Number: 0523756

Provisional Title: Dependency in the Context of Game Development

Abstract: In computer games, often you may have some objects set to be "children" of

another: they have fixed local coordinates to their parent, such that when it moves they must update their positions also. There may even be a hierarchical system of such objects.

There are obvious dependencies here, so a system in which these were automatically maintained could potentially reduce development time significantly. However, not all components of a game will be so well suited. We should not force the use of empirical modelling concepts and dependency where it does not make sense.

I will investigate what areas within game development are particularly suited to the use of dependency and where it is harder to use effectively. Where it is unsuitable I will attempt to examine why it is unsuitable and what can be done to reduce this effect.

Model description: In game physics, a ragdoll is a set of rigid bodies connected by joints: usually to give a rough approximation of a human skeleton. These are then used to produce a simulation of realistic movement including collisions with the environment. A common use is to animate the bodies of dying enemies interactively (rather than using the same prerendered animation every time).

This is a situation where there are obvious dependencies (this point on this object is attached to this point on this other object) but they may not be trivial to compute.

I will attempt to model a ragdoll simulation with both dependency-based and traditional approaches. Initially this is likely to be in two dimensions, but if it goes well could be extended to 3D.

I intend to use Doste with C++.

References: Unknown?

Weighting: Paper - 40/Model - 60 (Paper not exceed 4 pages)

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There are some interesting issues to be addressed here, but it will be important to identify them clearly. Perhaps a good format for the paper would involve some prototyping for each of several key topics. I have in mind that one issue might be screen maintenance, where the objective is to keep an image updated, but it is not appropriate to expect that this is done in such a way that the screen state is strictly absolutely up to date at all times. It's important to show awareness of the idea of dependency being defined in the view of an agent - for practical purpose, in the view of the human observer, the sceen may be seem to be maintained up-to-date with reference to an internal model whether or not it is updated whenever the internal model changes. Ideally, you could do with a title that is less bland, and suggests more about your intentions in the modelling study.

More generally, its important to consider the way in which you use the term 'dependency'. You talk about 'forcing EM concepts and dependency where it does not make sense," about 'where dependency is unsuitable' and about 'what can be done to reduce this effect', but I'm not sure what this means. Either there is or isn't a perceived dependency - An agent registers a dependency when it is the case that if x is changed, y changes "at the same time" in a predictable way. Interpreting "this point on this object is attached to this point on this other object" as a dependency in such terms also requires some effort of the imagination. The issue may be more to do with whether such a dependency can be convincingly embodied in an artefact. You will need to be careful in using DOSTE in this connection; it is a useful platform in which to address efficient maintenance of dependencies and agency, but only highlights these concepts in the EM sense when exercised in particular ways.

Name: James Silver

Library Card Number: 0503096

Provisional Title: What Can Be Modelled? An exploration of the limits of Empirical Modelling.

Abstract: Empirical Modelling, based upon the concepts of construal and observable, advocates an experience-based approach to computing, where different states are explored and understood by the user through experience and experiment. In the tkeden system the relationship between states are defined as dependencies between observables and systems such as LSD are aimed at providing the ability to model distinct, but interacting agents within a system. One promising area of application is that of constructivist education methods, and many such models have been produced for this purpose.

This paper explores where such a modelling approach may find itself to be limited, and it aims to discuss when modelling with the currently available environments becomes complex, why this is so, and to provide some answers to the resulting question, when does it become unviable?

Such limits to modelling in Eden and LSD come about through the complex nature of the 'observable' and that the relationships between them are often very subtle, sometimes abstract and are often affected by many different considerations. This immediately causes difficulties when defining such relationships, as such definitions must be made explicitly and concretely in order to be suitable for the Eden environment. An example of such a situation is that of the interaction between humans who, in reality, gather information through many senses and often make assumptions based on what they perceive to be true. Such a perception is dependant on worldview, perspective and situation. It may therefore be the case that some observables are dependant on all already established facts about an agent, many of which may at first seem unnecessary, and are tied together by an understanding of the human mind which has not yet been obtained by modern science.

It is clear that such a relationship between observables quickly become unviable to model concretely or accurately. As such it might be of worth to consider observables that have an element of non-determinism about them, and about the way they interact with other observables. The suitability of such an approach is explored in this paper.

As an example of such complex relationships between agents, a model of the Abermule train disaster is attempted and referred to throughout.

Model description: The Abermule train collision occurred when a misunderstanding between the staff at the Abermule train station caused a train to make its way down a single-line section that it was not cleared to move down and it collided with an express train coming the opposite way.

In place to protect such an accident was Tyer's Electric Train Tablet system, which had an instrument at each station on the single-line section that would only vend a tablet for a section of track when there were no tablets already checked out for the oncoming direction for the same section of track. The machines were synchronised with each other by telegraph and it was thought to be a foolproof system.

The accident came about when a miscommunication from the ticket-collector to the station-master led the station master to assume that the next station of track was cleared and that he was holding in his hand the appropriate tablet when in fact the ticket-master had just handed to him an old tablet and the next part of the track was not cleared. Neither he nor the driver of the train he directed to continue forward checked the identity of the tablet and it proceeded into the path of an oncoming express train.

The agents in this system are: Abermule stationmaster Lewis, Signalman Jones, a Sub-inspector, ticket-collector Thompson, porter Rogers and the drivers and firemen of the two trains involved in the collision. The tablet system will also need to be modelled.

The purpose of the model is to explore the viability of modelling such a scenario and if so, how it might be done.

References:

- "Comparison of SDL and LSD" (1987), W M Beynon and M T Norris
- "Bicycle Drive Train Simulation" (http://www2.warwick.ac.uk/fac/sci/dcs/research/em/publications/web-em/01/bicycle.pdf)
- Jaratsri Rungrattanaubol April 2002 A treatise on Modelling with definitive scripts
- "The interpretation of States: a New Foundation for Computation?" W M Beynon, S B Russ
- "Modelling State in Mind and Machine" Meurig Beynon
- "A definitive notation for behaviour in Empirical Modelling?" ['Doste'], Nicholas Pope
- "The LSD Notation for Communicating Systems" Meurig Beynon

Weighting: Paper - 60/Model - 40 (Paper not exceed 6 pages)

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This is a good theme for a paper in principle. I'm not sure how far your theme is really concerned with the limits of Empirical Modelling, rather than the limitations of current tools (like EDEN or the ADM) and notations (like LSD). Perhaps it would be good to find a more focused title - possibly even one that refers to the challenges of modelling the Abermule accident scenario effectively. A good plan might be to review the accident and isolate specific issues that are challenging to model (such as modelling location-specific privileges; handling tacit knowing mediated by action; reconciling diverse personal views and knowledge with the perspective of an external observer). Issues like non-determinism have more to do with the interpretation of observables in an interactive context than with the nature of the observable itself and seem to me to enter the picture when only you animate. On the whole, I would recommend not associating autonomous change with observables initially to any great extent, but considering how you might / what you would need to do to set up an interactive environment in which the human agents in the accident scenario were present, and where you could play out the accident scenario.

As it stands, your abstract is rather loosely written. I'm not sure that "the concepts of construal and observable" is a good characterisation, of that LSD is a 'system'. You refer to "One promising area of application ... " without referring to its relevance to your study which detracts from the sense of focus. Your reference to "an understanding of the human mind which has not yet been obtained by modern science" suggests a philosophical orientation that is not best-oriented for EM. Experiencing connections between a construal and a referent is not predicated on understanding how these connections come about - it is enough that the connections ***are*** *experienced, whether or not we can explain this. Also beware the standard mistake when referring to "dependency" and "dependent" of writing "dependancy" and "dependant."*
