

Not in the Notes: Empirical Modelling applied to Schubert's Erlkönig

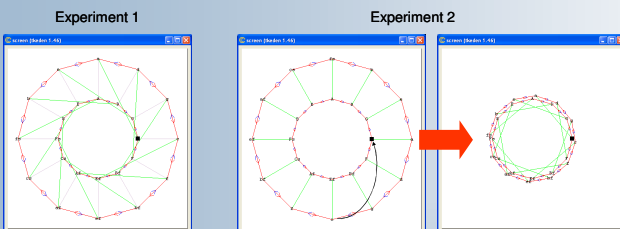
Meurig Beynon
Empirical Modelling research group, Computer Science, University of Warwick, UK
<http://www.dcs.warwick.ac.uk/modelling/>

Goethe's **Erlkönig** was inspired by a true incident of a father who, late at night, took a long ride to a doctor's house in a distant town and, on his arrival there, found his sick son dead in his arms. Schubert's setting of the poem dates from 1815. It is one of the earliest and most celebrated of the more than 600 songs that he composed. It is renowned for its taxing accompaniment, in which the right hand has to sustain a repeated triplet rhythm that conveys the intensity of the horse's unrelenting ride.

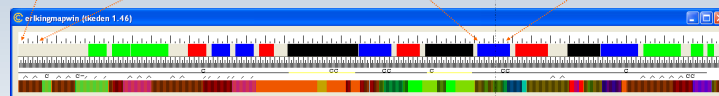
Erlkönig is a ballad in which the singer plays the roles of the narrator, the child, the father and the Erlkönig. A core ingredient of our model is a map of the song, in which each role is represented by blocks of a specific colour: green, blue, red and black respectively. This map is depicted on the right, accompanied above by extracts from the music on which the map is based, and below by a 'cartoon strip' version of the text of the poem. The map includes simple iconic representations of musical textures and motifs that occur throughout the song, together with a coloured ribbon that reflects the progression of harmonies. The map is a compact representation for Erlkönig that highlights various aspects of Schubert's artistry: the predominant use of major keys in conjunction with the Erlkönig's role; the associated suspension of the repeated triplet texture, as if – as Tovey remarks – the perspective shifts from that of the external observer to that of the child; the obstinately static tonality where the horse's ride is at its most urgent; the remoteness of the destination to which this desperate ride finally leads.

The principal focus of our model is understanding the harmonic structure of Erlkönig. This structure is based on the well-known classical cycle of 12 major/minor keys. A simple Schubert song, such as Der König in Thule, is readily described and analysed with reference to the cycle of keys alone. For instance, the diagram to the right can be used to simulate the transitions between keys as they occur in performance of the song by simultaneously indicating the current key in the cycle of keys, and by rotating a suitably developed colourwheel to highlight the colour that represents the current key. The colour metaphor is reinforced by changing the background for the cycle of keys diagram from white to black as the music modulates from a major to a minor key.

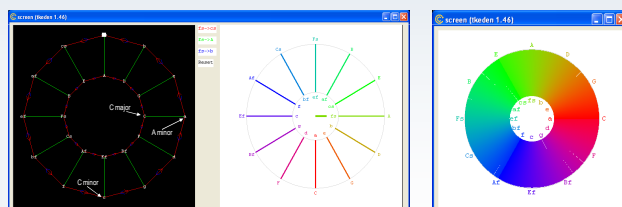
In the classical cycle of keys, the minor key that stands in the nearest musical relation to a major key is its relative minor, so that A minor and C major are linked by an edge. A characteristic feature of Schubert's harmonic style is his use of the major and minor keys associated with the same tonic note (such as C major and C minor) in close conjunction. In modelling Erlkönig, it became clear that this musical effect subverts analysis of the harmonic relationships with reference to the classical cycle of keys alone. This prompted experimental model-building aimed at capturing Schubert's distinctive harmonic idiom.



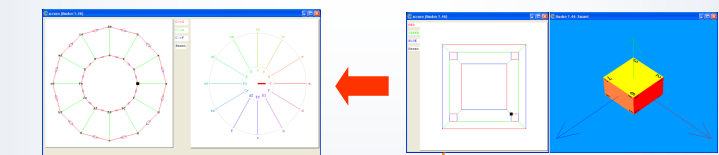
In Experiment 1, the proximity of tonic major and tonic minor is modelled by adding purple edges (each defined by tracing a green edge followed by three red edges) to the cycle of keys. To make the relationship between tonic major and minor symmetric – as that between major and relative minor is deemed to be in the traditional cycle of keys – the direction of the red edges on the outer ring of the cycle of keys must be reversed. This leads to a variant of a diagram described by Waller in 1977. In this context, Waller's mathematical model is unconvincing, since the reorientation of the red edges is not musically justified. A closer analysis of Erlkönig shows that – where the tonality is obscure – tonic major and minor are conflated rather than merely juxtaposed. This has motivated our adoption of the alternative approach suggested by Experiment 2, in which the abstract form of the cycle of keys is preserved, but the diagram is transformed so that the nodes that represent the tonic major and minor keys become coincident.



The horse rides in the night ... The child fears shadows ... The Erlkönig entices ... the f. reassures ... the c. cries in anguish ... the E. compels ... the f. drives the horse ... The father asks after the child ... he dismisses the fear ... the c. cries out ... the E. beguiles ... the f. rebuffs fear fiercely ... the c. despairs ... The c. is dead



A map of Erlkönig ↑ and of the modelling activity ↓



- developing the Cycle of Keys model, adapting a Cayley diagram showing symmetries of a cube
- developing a colour wheel for the tool
- making the map for Erlkönig, envisaging how the various elements of analogy - with music and words both in German and in the English translation can be embodied in the artefact
- incorporating a simulation of a performance of Erlkönig
- conducting an experiment to embody Schubert's innovative use of tonic major and minor keys
- rediscovering a variant of Waller's mathematical model
- performing a harmonic analysis, and integrating this with the cycle of keys model
- prototyping semi-automatic harmonic analysis on Schubert's King of Thule
- developing a screen keyboard for music input
- adding the visualisation of the conventional musical representation
- adding the musical motifs to the map
- depicting the harmonic texture on the map

In discussing *how modelling works*, Willard McCarty (2005) identifies a variety of concepts that overlap that of *model* as it applies to computing for the humanities:

- map** - a diagram of anything that can be spatially conceived
- analogy** - resemblance of things with regard to circumstances or effects
- diagram** - a figure where the relations between parts illustrate other relations
- representation** - an image, likeness, or reproduction in some manner *or* a symbolic denotative correspondence, not a likeness or imitation
- simulation** - imitating the behaviour of some situation or process
- experiment** - an action or operation undertaken ...
... to discover something unknown *or* to put anything to test

McCarty stresses the significance of *modelling* as an open-ended activity, and the status of the model as 'a temporary state in the process of coming to know'.

The various artefacts depicted on the poster illustrate how McCarty's vision for modelling can be realised using the principles of Empirical Modelling (EM). Taken as a whole they make up a loosely integrated model in which each of McCarty's six concepts is represented. They are the products of an ongoing collaborative modelling exercise being undertaken by Meurig Beynon and Karl King.

Model-building in EM evolves through an extended process of observation and experiment in which exploration and negotiation of meaning play a fundamental role. Where conventional computer programming is like specifying a composition for an established instrument, EM more closely resembles *rehearsing* a composition *whilst it is being written* on an instrument *that is in the process of being devised*. Even when an EM exercise has a specific objective, aspects of the modelling typically lead to artefacts of tangential or ephemeral interest – cf. the adapted cycle of keys, to incidental extensions of the instrument with other potential applications – cf. the colourwheel and keyboard, and suggest directions open for further exploration – cf. the map of the collaborative modelling activity on the left below.

McCarty's model-related concepts admit dual interpretations according to whether the modelling activity is open or closed. In contrast to traditional computer-based modelling, EM emphasises those variants favoured by openness and interaction:

- analogy** – not mere structural similarity, but **conjunction experienced in live interaction**
- map** – not merely recording what is established, but **tracing what is in the making**
- diagram** – not as mere static artefact, but as a **live embodiment of latent change**
- simulation** – not as mere automation but as **living performance**
- experiment** – not as mere justification but as **genuine discovery**
- representation** – not as mere symbolic denotative correspondence, but as **meaningful likeness open to exploration and negotiation**

Our model of Erlkönig is quite limited in its scope – for instance, melodic and linguistic elements have been neglected. The model lacks many virtues of a complete well-engineered finished product with a well-defined function: it is of interest primarily because of the way in which it is *unfinished*. More generally:

- The quality of an EM artefact does not reside chiefly in what it represents, but in its potential relationship to what it does not represent.
- EM enlists meanings that evolve with experience, as when a representation of music migrates from being meaningless, to merely symbolic, to something *not in the notes*.
- Meaning is only to some degree enshrined in the artefact – it is more appropriately regarded as elicited afresh on every interaction.
- EM enables us to trace activities that are involved in negotiating meanings.
- EM is *modelling in the space of sense* – enabling and enacting experiential counterparts of transformations that have meaning in the referent.