Thinking About Arrangements and Fractional Zero Modules

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When preparing myself for teaching a new call in a class, I always try to review what worked well in the past and also what was not a good way to go. I try to look at the calls through the eyes of beginner dancers and adjust the amount and form of information I want to transfer accordingly. An important part of the process of teaching is practising new calls from several different positions—although we cannot cover all possibilities in most cases, we can at least try to go through all starting formations and arrangements that are considered standard or that are being actually used.

This train of thoughts led me to the following idea: it would be nice to be able to create combinations of calls that would cycle all possible arrangements of a certain formation for a given call. In other words, I am looking for a fractional Zero module, and since we have six possible arrangements, we generally want to have 1/6 Zero modules (and we also know that some 1/6 Zero modules do exist).

Have you ever tried to create a 1/6 Zero module from a scratch? It is not as easy as it could seem—if you do not have any system, you will probably end with a handful of 1/2 Zero modules and also some 1/4 Zero modules after some time, but that is all. The key to further expansion is employing different arrangements of the starting/ending formation—this method can result in 1/3 Zero modules and, hopefully, some of the desired 1/6 Zero modules, too. However, a closer look tells us that using six iterations does not mean getting six different arrangements. At this point, it is wise to use some maths and find why is it so and what to do about it.

Firstly, we need to clarify a few things:

- We are working with symmetrical setups of eight dancers only (because non-symmetrical setups are always special cases, and symmetrical setups of less than eight dancers obviously do not allow smaller fractions than 1/4).
- We are looking for modules that work as fractional Zero modules and that do not change the formation: the starting formation is the same as the ending one.

Therefore, each iteration can be represented as an oriented graph of eight vertices and eight edges; each vertex represents a position of a dancer within the formation and each edge represents the movement of the dancer from the particular spot to another after one iteration of the module.

What matters now are the cycles in the graph (subsets of vertices that are connected together by edges). There are cycles of eight, six, four, three or two vertices or even one vertex possible to be found. We can basically say that the number of vertices in a cycle determines the number of iterations (the fraction of a Zero module) required for re-establishing the initial state; however, due to the “mirror image effect”, all cycles containing some vertices together with their mirror image ones (which is the case of all 8-vertex and 6-vertex cycles and some 4-vertex and 2-vertex cycles) are symmetrical and the original state is re-established half-way through the sequence of iterations. This means that an 8-vertex cycle can represent a 1/4 Zero module and a 6-vertex cycle can represent a 1/3 Zero module (a 4-vertex cycle can represent a 1/2 Zero module and a 2-vertex cycle can be a Zero module itself in certain situations)—what matters now is the mutual orientation of cycles.

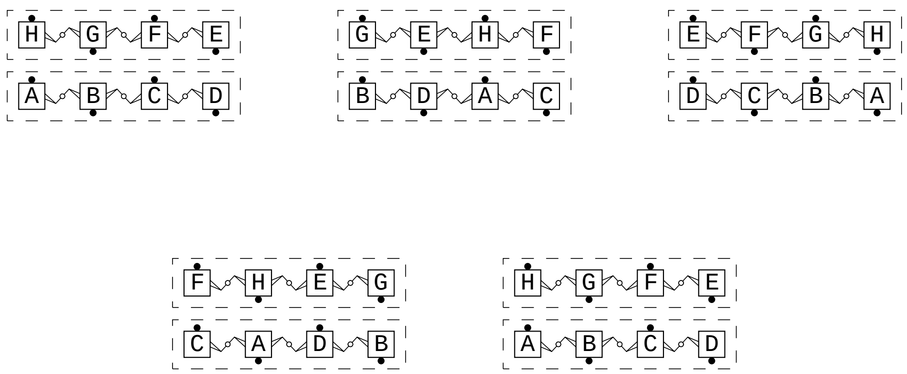

Figure 1: *Swing Thru* is a 1/4 Zero module; the cycles are A-B-C-D and E-F-G-H.

Cycles can be distributed within the graph in the following ways:

- **One cycle of eight vertices.** This is a 1/4 Zero module.
- **One cycle of six vertices, one cycle of two vertices.** The 6-vertex cycle is a 1/3 Zero module, the 2-vertex cycle is a 1/2 Zero module. Together they give a **1/6 Zero module** (their lowest common denominator).
- **One cycle of six vertices, two cycles of one vertex.** The 6-vertex cycle is a 1/3 Zero module, the 1-vertex cycles are Zero modules themselves (1/1 Zero modules) but they require the 6-vertex cycle to be a **1/6 Zero module** if we want to achieve the “zero” effect for all eight dancers.
- **Two cycles of four vertices.** They are both either 1/4 Zero modules, or 1/2 Zero modules.
- **Two cycles of three vertices, one cycle of two vertices.** The 3-vertex cycles are both 1/3 Zero modules, the 2-vertex cycle is a 1/2 Zero module. Together they give a **1/6 Zero module**.

- **Two cycles of three vertices, two cycles of one vertex.** The 3-vertex cycles are both 1/3 Zero modules, the 1-vertex cycles are both 1/1 Zero modules. Together they give a 1/3 Zero module.
- **Other combinations of zero or more 4-vertex, 2-vertex and 1-vertex cycles.** The 4-vertex cycle is either a 1/2 Zero, or a 1/4 Zero module in this case, 2-vertex cycles are 1/2 Zero modules and 1-vertex cycles are 1/1 Zero modules. Together they give a 1/2 Zero module or a 1/4 Zero module.

This discussion indicates that 1/6 Zero modules exist (we already knew that) and it also presents some clues for finding them. However, we now want to focus on about arrangements. All three ways of distributing the cycles so that the result is a 1/6 Zero module employ either one cycle of two vertices, or two cycles of one vertex. The only possible way of establishing the 2-vertex cycle is using two vertices that are symmetrical to each other; in other words, this cycle will be swapping two dancers who are mirror image copy of each other. This means they are both of the same gender, so their particular positions will be always occupied by dancers of one gender only. The same is true for 1-vertex cycles where the positions within them are occupied by the same dancer all the time. Regardless of how hard we might try, we can never cycle all six arrangements of the respective formation if some positions are constantly blocked by one gender (which leaves just three possibilities of distributing the other dancers from the arrangement point of view). Therefore, my idea of having one module for cycling all six arrangements of a formation can never be fulfilled; however, this also means that I will have to go on using my "standard" methods of practising which surely do not let my brain get lazy—and that is certainly good news, isn't it?

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