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**Tools for the Visualisation of
Scottish Country Dances**

4th Year Project Report

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Abstract

The aim of the project was to provide tools to make it easier for beginners to learn Scottish Country Dancing. The approach taken was to provide a tool to allow dances to be animated. Scottish Country Dances were analysed for structure, and from this a file format and an internal data structure were derived. A parser was written to build the data structure from files in the specified format. A module was then developed to produce animations of these dances.

Acknowledgments

Thanks are due to my supervisor, Frank Stacey, for many chats throughout the year, some of them even relevant to the project. His advice on matters related to both computing and dancing has been most useful, not least for getting me thinking about other avenues of exploration and alternate approaches to problems.

Thanks are also due to Rob Procter for referring me to Stéphane Chatty's paper ([17]).

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1. Introduction

There are three major forms of dancing in Scotland. First there are the Highland dances, such as the Sword Dance and the Highland Fling. These are mainly solo dances, with the emphasis on footwork. Then there are the ceilidh dances. These are couple dances in the main. They are known to many and done with much vigour and laughter, but seldom with any great finesse. Finally there are the Scottish Country dances. It is with these that this project is concerned.

These involve groups, or “sets”, of six, eight, ten or sometimes more dancers in couples with a “man” partnering a “woman”, although sometimes due to a shortage of one sex or the other some men are female, or (less commonly) women male. The dancers in the group co-operate to describe patterns, or “figures”, of varying complexity. A dance generally consists of a sequence of these formations which leaves the dancers in a permuted order; the dance is repeated until all dancers are back in their original places.

Since there are around fifty basic figures, and more are being created all the time, there is clearly the potential for a large number of different dances. Indeed one count puts the number at around 10 000 [16]. This makes it difficult to remember which dance is which. Also the number of figures is a great barrier to beginners learning to dance.

There are a couple of representations in common use nowadays. One is a textual form as used by the Royal Scottish Country Dance Society (RSCDS) [3]. This is descriptive, but can lead to confusion through sheer weight of words and the need to learn the terminology. Accordingly, in 1955 F. L. Pilling brought out a book [1] which describes the dances in a more diagrammatic mnemonic form. These diagrams can also get involved and confusing, and both forms require the reader to be familiar with the formations. The two representations are described in more detail in chapter 2.

The aim of this project is to provide tools to aid the user in visualising how figures work, and how they combine to make dances. It does this primarily through animation.

A file format has been developed with the aim of denoting dances in a compact yet human-readable form. This draws from both the structure of dances as determined during the development of the data structures, and from the standard text crib format. An interface has also been developed using the MS Windows operating environment. This allows the easy editing of files as well as viewing of the animations using video recorder style controls.

Note on the use of the personal pronoun

To avoid awkward constructions the feminine forms of the personal pronouns, *she* and *her*, will also be used to mean *he*, *him* and *his* throughout this report.

2. Existing methods of description

The methods of description which currently exist are discussed here. A brief description is given of each, and their strengths and weaknesses detailed.

The descriptions covered are:

1. Text Cribs, as published by the RSCDS.
2. The diagrammatic form developed by F.L.Pilling.
3. An MSc by Richard Goss at the University of St. Andrews dated 1984.

2.1 Text cribs

These are typified by those published by the Royal Scottish Coutry Dance Society [3]. Figure 2.1 gives an example, taken from RSCDS book 1.

Cribs in this format are written in English prose, with set guidelines for how concepts should be expressed. As can be seen from the example, such a crib has a header giving the name of the dance and its type. Its source is also often quoted, as well as the initial configuration of the participating dancers, and requested tunes.

There then follows a list of bars, together with instructions. These instructions are given using standard terms and following approximately the same structure every time, namely *participants actions [extra information] [finishing positions] [“while” participants ...]*.

By using standard English this notation can be as expressive as the devisor of the dance or the writer of the crib can make it. However the prose lacks a definitive formality which can lead to differing interpretations of the same dance when it is danced by different groups. It can also become extremely verbose, which drastically slows down the process of reading and understanding the instructions.

The standard terms and layout mean that someone familiar with the format can find information quickly and efficiently. The down side of this is that the jargon makes the description all but impenetrable to the non-expert reader.

2.2 Pilling-style diagrams

These were first published in 1955 by F. L. Pilling [1]. They have been taken over by a committee, revised several times to add new (or missing) dances and to make the notation more consistent, both with itself and between dances. The book is currently in its sixth edition [2].

Figure 2.2 shows a sample dance using this notation. It is of a dance which was devised to look impressive in this notation and so is more complex than the average diagram. It should still give an idea of the format. For comparison, the textual version spans several pages.

The approach taken by Mr Pilling was to denote figures using diagrams, with set mnemonic symbols for common figures. For instance a circle is represented by a circle with the number of people involved given in the centre. A reel, which is like a figure of eight for three people, or a figure of eight with an extra loop for four people, is shown as two (or three, or $n - 1$ for n people) small circles side by side and touching in a line.

Duke of Perth

RSCDS I-3

(Reel)

Four couple longwise set

Tune: Duke of Perth's Reel.

Music

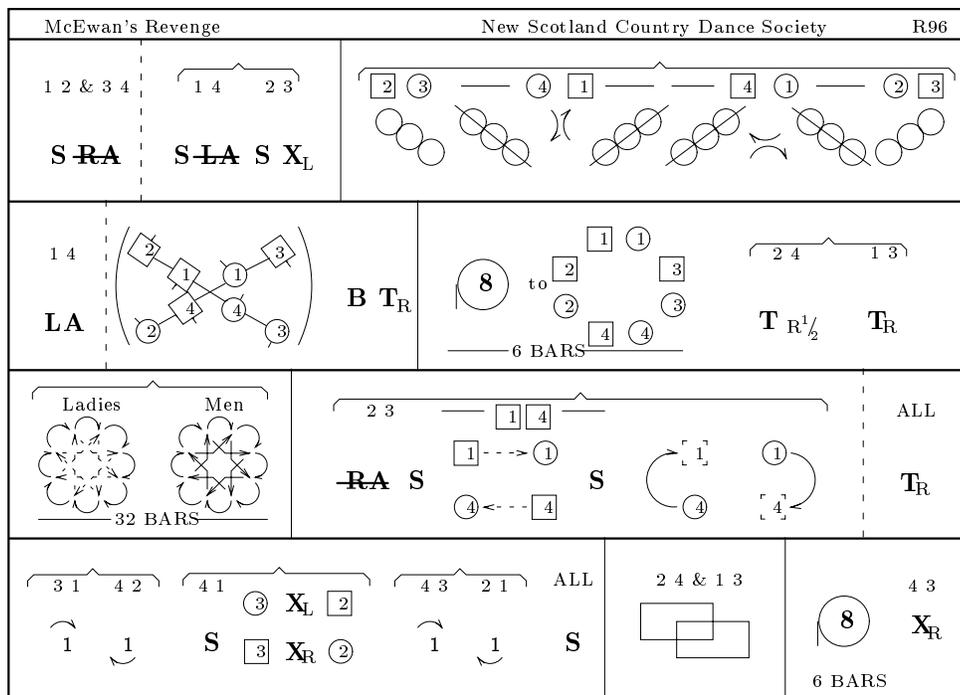
Description

Bars

- 1-4 1st couple turn with right hands and cast off one place on own sides. Second couple step up on bars 3-4.
- 5-8 1st couple turn with left hands to face first corners.
- 9-10 1st couple turn corners with right hands.
- 11-12 1st couple turn with left hands to face second corners
- 13-14 1st couple turn second corners with right hands.
- 15-16 1st couple turn with left hands to face first corners.
- 17-20 1st couple set to and turn first corners.
- 21-24 1st couple set to and turn second corners.
- 25-30 Reels of three on the sides, 1st woman with 2nd and 3rd men, 1st man with 3rd and 2nd women.
- 31-32 1st couple cross over to own sides, in second place.

Repeat, having passed a couple.

Figure 2.1: "Duke of Perth"—a sample dance in the text crib format. From RSCDS book 1.



Notation courtesy of F. L. Pilling. Used with permission from F. L. Pilling's successors. Dance copyright EUNSCDS 1994

Figure 2.2: “McEwan’s Revenge”—A sample dance in the format used by Pilling

Many of the common figures have representations which take up much less space than written forms. This is the main strength of this format, in that it allows a dance to be expressed extremely compactly and hence it is possible to remind oneself of how a dance runs in a matter of moments.

That is all very well, and obviously the diagrammatic mnemonics, where used, have international application. Other mnemonics are less intuitive. For instance a bold-face S is used to indicate a setting step, and a T for a turn. This is all right for the English-speakers, once they have learned the notation, but not necessarily so for people in other countries. A German would not find “T” an intuitive shorthand for *drehen*. Furthermore, figures for which no symbol has been defined are shown by name: “TOURNÉE” in *From Scotia’s Shores we’re Noo Awa’* [2], for example. It is no more obvious what is meant here than when it occurs in the RSCDS-style cribs if the movement is unfamiliar.

Another failing of this format is that it does not give the qualifying information about a figure which may be given in an RSCDS-style crib, and so is even more open to differing interpretations. To be fair, the notation was never designed for this. In the preface to the sixth edition they say:

We should like to emphasise that the book is designed as an aide-memoire and, although we have tried to include as much detail as possible in diagrammatic form, anybody who wishes to learn a dance should refer to the original printed instructions.

Where a movement is non-standard Pilling uses arrows—solid for men, dashed for ladies—to trace the path followed on a representation of the set. This is fine for simple movements, indeed it is often a lot clearer than the corresponding RSCDS-style description, but it can get messy when there are several people moving at once.

Finally, some movements, such as two couples changing places on the sideline, are much easier to express in text than in the Pilling format. The corresponding representation would explicitly show the women and men simultaneously “crossing”, as near the bottom left-hand corner of figure 2.2.

2.3 MSc thesis by Richard Goss

Richard Goss’ thesis submitted as part of his MSc in Computational Science at the University of St. Andrews in 1984 [16] was entitled *Computer Plotting of Country Dance Figures*. It was borrowed and studied in the hopes that it might contain some useful information.

He was concerned with methods of expressing Country Dances which were totally unambiguous, culturally independent and standard. His approach was to build a database of figures which could be referred to by another database of dances. This way figures would be described in the same way every time. The figures database could be used to produce textual descriptions of the figures, or to generate FORTRAN code to operate a plotter. The dance database was organised to allow searches by name, devisor, source, tunes or component figures.

This approach required the user to learn the various contractions used to refer to the figures. It resulted in extremely compact representations which were totally unintelligible.

For instance

```
927R1(21R)CORN_RIGS/A6M1_ _ _ASI1_ _ _AGG1_ _ _C8P2_ :969PI
```

produced, after being run through his program:

```
CORN RIGS is a 32 bar (duple minor) Contra in 2/4 (Reel or Hornpipe)
time.
RSCDS(1927): progression=1. Secondary source(s) - 1969PI
1:cast;cast up;
1:figure of eight across; (in down);;
1:down and back;
12:poussette;
```

The figure definitions, sources, progressions, text and graphics plots were all hand-coded. The programs he developed were purely administrative.

2.4 Shortcomings

A major problem facing a beginner is learning the basic movements, and how these movements fit together in dances. The methods of notation described above all fall down here. They all assume that the dancer is familiar with the figures and the jargon, and that she can visualise how the movements follow on one from the other.

The main aim of this project was to provide a suite of tools to tackle just this problem: to aid dancers in learning dancing and dances. These were intended to allow the user to extend the functionality with relative ease, something not provided by Richard Goss’ system. This would mean the collection of dances could be as up-to-date as required.

Various possible avenues of exploration were considered, the following being some of the more prominent:

1. A representation of dances which allowed them to be stored efficiently. This also needed to be possible to be read by humans, to allow easy verification.
2. A parser which would read in files in a format very close to the text crib format described in section 2.1, and convert them to an internal representation for further use.
3. A module which would take dances in the internal representation and use them to generate the corresponding cribs, in either RSCDS-style or Pilling-style format.
4. A module which would take dances in the internal representation and from them generate an animation, which would allow people to see the paths traced by the various dancers as the formations develop.
5. A module which would allow the easy generation of dances, much in the manner of a painting program. This would be simplified by having an engine for drawing cribs, such as the Pilling generator in 3 above.
6. A module to allow dances to be found according to various criteria: name (complete or partial match), devisor, figures occuring, etc. This would require the dances to be held in a central database of some form.
7. A module to aid the writing of ball programmes. There are guidelines for putting together such programmes, most of which are common sense. Also a mix of dances is recommended, with as wide a spread of figures as is possible. A database such as described in 6 above would help ensure this.
8. The incorporation of music into the database, and/or musical accompaniment to the animations.

Many of these require an internal representation, and so the development of a data structure which could be expanded to cater for most, if not all of the above options was made a priority. Also some method for getting dances into the computer was needed. 1 and 2 were the only two options which provided this. It was decided to take the route of 1, while ensuring the file format was comprehensible to humans and so could be written by them. This had the major advantage of speed: if little attempt was made to model English prose and the file format matched the data structures the development of the compiler would be made much easier.

4, the animation, was chosen as the next path to follow, as this seemed to pose the most interesting and novel challenges. It also had the benefit of using the computer to provide functionality which paper-based media could never hope for. It was felt that it would also be the most useful avenue for teaching people dancing.

The crib generators and devising module, 3 and 5, were planned as the next stages, but unfortunately had to be abandoned due to pressure of time.

3. The structure of Scottish Country Dances

This chapter discusses the structure inherent in Scottish Country Dances. After defining the dancing terminology used throughout the report, dances are analysed to determine their basic make-up. This analysis is used in later chapters when developing a file format and data structure.

3.1 Terminology

3.1.1 Orientation terms

A dance starts with the dancers arranged in groups, known as *sets*. Normally the members of a set are paired in *couples*, of which one person is nominally a *woman*, and the other is a *man*. Due to shortages of one sex or the other, “men” may be female or, less commonly, “women” may be male. From now on I will use “men” to refer to dancers dancing as men, and “women” or “ladies” to refer to dancers dancing as women.

Where one couple has significantly more work than the others they are referred to as the *leading* or *dancing couple*. If there are two or more couples in this situation they are referred to as the *dancing couples*.

Sets are oriented with the *top* being the section of the perimeter nearest to the music.

There are two common styles of set: *longwise* sets and sets based on a circle. A third style sometimes used is *round the room*. These are described below, together with terminology peculiar to each.

Longwise sets

Longwise sets are arranged with a row of men facing a row of women. Each person has their partner directly opposite. People in a row are evenly spaced. The men have their left shoulders to the music, and hence the top of the set, and the women have their right shoulders to the music. The couples are numbered consecutively from the top of the set.

The two *sidelines* are imaginary lines drawn through the correct starting positions of the women and of the men. These are straight and parallel. The *women's side* is the sideline on which the women start, and the *men's side* is similarly defined for the men. A location in the *centre* or *middle* of the set lies on a line parallel to the sidelines, half way between the two. A dancer is said to be on her *own side of the dance* if she is on the same sideline as she started the dance. Correspondingly, she is said to be on the *opposite side of the dance* if she is on the other sideline. These are usually shortened to *own side* and *opposite side* respectively. The term *wrong side* is often incorrectly used where *opposite side* is meant.

Positions are described according to who occupied that location at the start of the dance. So for instance “first man's position” is the topmost position on the right hand sideline as viewed from the top of the set. Also “third woman's position” is the third nearest starting location on the left hand side, again viewed from the top of the set. If it is clear from the context where the intended location lies along the line drawn between the couple the specifier is usually dropped, giving (eg) “third position”. *Place* is used interchangeably for *position*.

In a longwise set *up* means towards the top of the set, and *down* or *off* means away

from the top. The end of the set furthest from the top is naturally enough called the *bottom*. *Above* and *below* follow as would be expected.

The orientation *up and down the set* means parallel with the sidelines, and *across the set* means at right angles to the sidelines. These are often shortened to *up and down* and *across* respectively.

A common arrangement has the dancing couple back to back in the middle of the set, with the woman facing the men's side, and the man facing the women's side. The positions above and below them are occupied by dancers on the sidelines. In this situation the dancing couple are said to be facing their *corners*. The person on their right is their *first corner*, with the person on their left their *second corner*. Continuing anticlockwise, some people use the terms *third corner* and *fourth corner* to describe their partner's first and second corners respectively. Note that the dancing couple and their first corners are on a diagonal line across the set, and similarly for the dancing couple and their second corners. This has given rise to the descriptions *first corner diagonal* and *second corner diagonal*.

This setup usually occurs with first couple as the dancing couple. They are in the middle of the set in second place. Second couple is above them in first place, on their own sidelines, and third couple are in third place, likewise on their own sidelines. The first and second corners are then people of the opposite sex.

Round the room sets

Such sets have the dancers arranged in two lines facing each other, with each line also having another set behind them. The sets make a large circle around the room, hence the name. The progression in such dances consists of the two lines passing to meet the next line of dancers.

Square, triangular and other polygonal sets

The other sort of set has the dancers arranged around the perimeter of a circle. The men have their partners on their right, and couples are evenly spaced. For obvious reasons such sets are called *triangular sets* if there are three couples on the perimeter, *square sets* if there are four couples, and so on. I will generally refer to sets of this type as circular or polygonal sets.

In some cases a dance has more than four couples in a square set. For five and six couples the extra dancers are generally in the centre of the set. For multiples of four dancers the dancers are arranged with two, three or more couples on each side of the square.

The term *corner* is also used in a circular set. In this case, however, each person only has one corner. This is the nearest person on the other side from their partner. So the men have their corners on their left, and the women have their corners on their right.

3.1.2 Other terms

There are three tempos of dance commonly used: *reels*, *jigs* and *strathspeys*. Reels¹ are in duple time, either $\frac{2}{4}$ or $\frac{4}{4}$. Jigs are in $\frac{6}{8}$ time. Many dancers make no distinction between these two, as the steps used are identical for both and it takes a practised ear

¹Care must be taken to distinguish between the tempo *reel* and the figure of the same name, which occurs in all tempos.

to distinguish the duple beat from the triple. However all dancers can tell the difference between them and the strathspey. This is altogether slower and, theoretically, more graceful, and uses a different suite of steps. *Hornpipes* are just reels. When a dance is composed of sections in different tempos it is called a *medley*. For instance, the dance *Schiehallion* [2] has 64 bars of strathspey followed by 64 bars of reel.

A dance consists of the dancers performing a series of formations, or *figures*, which leave them in a permuted order at the end. The dance is then usually repeated a number of times until everyone is back in their original positions.

Dances are composed of *phrases*, usually eight *bars* long. One bar is the amount of music needed to complete the basic travelling step of the tempo. In most cases this corresponds directly to the bars of the music, but in some cases (notably $\frac{2}{4}$ reels) one dancing bar corresponds to two musical bars.

In many cases two dancers will be instructed to *pass by the left (or right) shoulder*. In this case they dance past each other so that the other dancer is on the specified side of them. This means that if they get too close the specified shoulders will collide.

3.2 Structure

In this section the general format of Scottish Country Dances will be discussed in order to highlight their inherent structure. This information will be useful when developing a data structure which represents them naturally. The dance “The Millwheel”, described in figure 3.1, will be used to illustrate this discussion.

As can be seen from the sample dance, the instructions consist of a preamble followed by a list of bar numbers with associated descriptions.

In the preamble are the details of the dance such as its name, its source, its type, the initial set layout and the tunes set. In the example the name is “The Millwheel” and the source is “Brockbank”, showing that it was written by someone called Brockbank. Its type is given as an “8x32 bar Strathspey”. This means it is in Strathspey tempo, the dance is 32 bars long, and is repeated 8 times in all. The initial set layout is given as a “Four couple longwise set”, and the tune is “Grist to the Mill”.

The instructions for the dance then follow. These take the form of a list of instructions. Each instruction is preceded by the numbers of the bars during which the formations should be carried out, followed by a description of the formations.

Consider the first formation:

1–8 1st and 3rd couples dance a double figure of eight, 1st couple crossing down and 3rd couple casting up to start.

This starts on bar one and finishes on bar eight. A list of participants is given, followed by the formation performed, with some extra information finishing the description off.

It is possible to have more than one formation being performed at a given time, for instance in bars 25–28.

25–28 1st couple pass first corners by the right shoulder and dance round their position back into the centre, passing their partner by the right shoulder to face second corners *while* 1st corners advance into the middle of the dance, turn once round right hand, and return to place.

This has first couple performing one movement—passing first corners by the right shoulder . . . second corners—and at the same time their first corners perform another movement—advance into the middle of the dance . . . to place.

The Millwheel
Brockbank
8x32 bar Strathspey
Four couple longwise set

Tune: Grist to the Mill.

Music

Description

Bars

- 1–8 1st and 3rd couples dance a double figure of eight, 1st couple crossing down and 3rd couple casting up to start.
- 9–16 1st and 2nd couples dance the knot: turn partner half-way round with the right hand into allemande hold, curve round and up the lady's side, release right hands and pass the ladies in front of the men into the centre, and continue turning left hand. Finish 2nd couple in first place, 1st couple in the centre of the dance facing first corners.
- 17–24 1st couple with 2nd and 3rd couples dance the Millwheel:
- 1–2 1st lady with 2nd couple and 1st man with 3rd couple dance right hands across in a wheel half way round.
- 3–4 2nd and 3rd couples dance left hands across in a wheel half way round *while* 1st couple chase 1/4 of the way clockwise round the set.
- 5–6 1st lady with 3rd and 2nd ladies, 1st man with 3rd and 2nd men dance right hands across in a wheel half way round.
- 7–8 1st couple turn 1 1/4 by the left hand to face first corners.
- 25–28 1st couple pass first corners by the right shoulder and dance round their position back into the centre, passing their partner by the right shoulder to face second corners *while* 1st corners advance into the middle of the dance, turn once round right hand, and return to place.
- 29–32 1st couple repeat the movement with their second corners, passing each other by the right shoulders at the end to finish in second place on their own sides.

Repeat, having passed a couple.

Figure 3.1: “The Millwheel”—A sample dance illustrating basic dance structure, concurrent motion and recursive definition.

Formations can even be built up out of simpler formations, as in bars 17–24.

17–24 1st couple with 2nd and 3rd couples dance the Millwheel:

- 1–2 1st lady with 2nd couple and 1st man with 3rd couple dance right hands across in a wheel half way round.
- 3–4 2nd and 3rd couples dance left hands across in a wheel half way round *while* 1st couple chase 1/4 of the way clockwise round the set.
- 5–6 1st lady with 3rd and 2nd ladies, 1st man with 3rd and 2nd men dance right hands across in a wheel half way round.
- 7–8 1st couple turn 1 1/4 by the left hand to face first corners.

Here the figure being danced is called the *Millwheel*. It is built up from four smaller groups of movements—a right hands across, a simultaneous left hands across and chase, another right hands across, and finally a left hand turn. Note that, with the exception of the starting details such as who wrote it, or which tunes to play, this definition is almost identical to the description of the dance itself. This suggests that dances have a heirarchical or recursive nature. In fact one could even go as far as to say a dance is a figure which is defined in terms of smaller figures, which may themselves be defined in terms of smaller figures, and so on.

This suggests that the figure is the basic unit to consider, rather than the dance, as may seem at first sight more appropriate. Having determined this the structure of a figure now needs to be ascertained. As can be seen from the sample, and from the figure on bars 17–24, a figure is composed of a list of sub-figures.

Consider bars 9–16:

- 9–16 1st and 2nd couples dance the knot Finish 2nd couple in first place, 1st couple in the centre of the dance facing first corners.

These form one sub-figure. There is an indication of when the movements occur (bars 9–16), who is involved (1st and second couples) and what they do (dance the knot). In this case there is also an indication of where the dancers finish the figure (Finish 2nd couple in first place, . . . first corners).

Who is involved, what they do and where they end up are all lists, of participants, figures and (participant,location) pairs respectively.

Since figures are recursively defined there need to be some base cases. The simplest level which could be taken is to consider these to be just a sequence of curved and straight-line movements, and express all other figures in terms of these. However some movements are so common as to deserve definition in their own right. These are the basic repertoire a dancer needs to know. Examples are *crossing*, *casting*, *reels*, *turns* and *hands across*. It was decided to stop the recursion at this level of definition. Such figures will be referred to as *atomic* figures from now on. The other figures, which are defined in terms of smaller figures, will be referred to as *composite* figures.

4. The file format—an intuitive description

This chapter gives an informal description of the language developed for entering dances for animation. It outlines the various features, and uses a sample dance file to illustrate these. The dance chosen for this description is the *Duke of Perth*, published by the RSCDS [4]. Figure 4.1 on page 13 gives a possible file for it in this format.

A dance file contains several figure definitions. These have three sections, separated by \$ symbols. The first section gives the identifying details about the figure. The second section deals with the initial configuration of the dancers, and the third provides a list of actions, together with their times. A final \$ symbol terminates the definition. The sections will now be explained in more detail.

4.1 The identifying details

The first section, the identifying details, contains the name of the dance or figure, optionally followed by a shorthand form to make the descriptions more compact. A further three items of information relevant to dances may then be added, each preceded by a \. These are the source or the deviser of the dance, the dance type, and the tunes set for it. Three fields must be provided if any are, but the source and tunes fields may be empty. The source and tunes are just strings as far as the program is concerned, with a \ and a \$ respectively marking the ends. The dance type is a number indicating how many times the dance is repeated to bring everyone back to their initial positions, an *x*, and another number indicating the number of bars in each repetition of the dance. This is followed by either R, J, S or H indicating whether the dance is a reel, a jig, a strathspey or a hornpipe respectively.

The Duke of Perth has the following header:

```
$ Duke of Perth \ RSCDS I,8 \ 8x32R \  
Duke of Perth's Reel $ 4CLS $
```

This shows it is from RSCDS I, 8 (RSCDS book 1, dance number 8), is an 8x32R: an eight times through 32 bar reel, and has tune “Duke of Perth’s Reel”. No shortened name has been given.

On the other hand, the figure **Corner-Partner** has this header:

```
$ Corner-Partner, CP $ $
```

It is not a dance in its own right, so does not have the extra details. It has provided a shorthand name, however: its name is **Corner-Partner** and its shortened name is **CP**. Note that case is not significant; **Corner-Partner** could be written as **CORNER-PARTNER**, **corner-partner** or even **CoRNeR-paRtNEr**.

4.2 The position section

The second section of a figure definition gives the initial configuration of the dancers. This section may be left empty for a subfigure, but must be specified for figures which

```

%% Sample file defining the dance Duke of Perth
  (from RSCDS book 1, number 8)
  -- this is a multi-line comment %%
$ Duke of Perth \ RSCDS I,8 \ 8x32R \
  Duke of Perth's Reel $ 4CLS $

1,2: 1C: T(RH); % First couple turn right hand
3,2: 1C: C(1) % First couple cast off one place
3,2: 2C: SU; % while second couple step up
5,4: 1C: T(LH); % First couple turn left hand
9,8: 1C,2C,3C: CP; % dance corner-partner
17,8: 1L,2M,3M & 1M,3L,2L: STC;
25,6: 1L,2M,3M & 1M,3L,2L: R(3,LS,100);
% 1st couple set to and turn corners (8 bars)
% and dance reels of three with their
% corners (6 bars)
31,2: 1C: X(RH);
% Finally, first couple cross over
% a single-line comment
$

% Defining the figures.

$ Corner-Partner, CP $ $
1,2: 1L,2M & 1M,3L: T(RH);
3,2: 1C: T(LH);
5,2: 1L,3M & 1M,2L: T(RH);
7,2: 1C: T(LH);
$

$ Set to and turn corners, STC $ $
1,2: #1,#2: S;
3,2: #1,#2: T(BH); % sets to first and turns
5,2: #1,#3: S; % repeats with second
7,2: #1,#3: T(BH);
$

```

Figure 4.1: A sample dance file—“Duke of Perth”

may be performed on their own, such as dances. The specification starts with a number giving the number of dancers. This is followed by one of two forms.

The simplest is a colon, and a position for each dancer, given as x and y coordinates, followed by an angle in degrees measured anticlockwise from the positive end of the x -axis, indicating the direction in which the dancer is facing. These coordinates are given in round brackets. $(100,100,270)$, the position of first lady in a longwise set, is an example. The brackets are used as delimiters.

The other form has a **C** following the initial number, and then a set-type marker. This can be either **LS**, meaning a longwise set, or **TS**, **SQS**, **HXS** or **CircularSet**, meaning a set with the couples arranged around the perimeter of a circle. A set with four couples arranged in a square, with one or two couples in the middle, as in *Gavin's Reel* (five couple) or *The Iona Cross* (six couple) is given as a **5cSQS** and a **6cSQS** respectively. Dances with several couples on each side of a square, such as *The Sixteensome Reel*, with two couples on each side, or eight couples in total, or *The Thirtytwosome Reel*, with four couples on each side, are given as **8cSqs** and **16cSqs** respectively.

Looking back at the Duke of Perth, we find it is given as a **4CLS**—a four couple longwise set. The two subfigures both omit the position, and so start with the dancers in the positions in which they are left by the previous figure.

4.3 The definition section

The definition section takes the form of a series of actions with start time “,” duration “:” a list of participants “:” a figure, optionally with a list of parameters enclosed in round brackets, and optionally “:” a list of destinations. The subfigure is terminated with a “;”.

The starting time and duration are given in bars. The list of destinations is a list of positions as in the first form of the initial configuration as described above. The participants in the list are separated by either commas or **&** characters. This allows the deviser to split them up into logical blocks. The participants are either a **#** sign followed by a number, so **#3** is the third dancer specified when the figure was called, or a number followed by **L** or **W** meaning woman, **M** meaning man or **C** meaning couple. In fact the second form is translated into the first: **1L** is translated to **#1**, **1M** to **#2**, **2L** to **#3**, and so on. **1C** is translated to **1L,1M** which itself translates to **#1,#2**, and similarly for the other couples.

Taking the Duke of Perth example again, we have:

```
25,6: 1L,2M,3M & 1M,3L,2L: R(3,LS,100);
```

This figure starts on bar 25 and lasts for 6 bars. The dancers are first woman with second and third men in one group, and first man with third and second women in another group. The figure, **R(3,LS,100)**, will be described below. There are no finishing positions given.

In set and turn corners, we have

```
3,2: #1,#2: T(BH); % sets to first and turns
```

This subfigure starts on bar three relative to the start of the figure, and last for two bars. So if the figure **STC** started on bar 9, this subfigure would occur on bars 11 and 12. The dancers are numbers one and two. Referring to the figure for the Duke of Perth, we see

17,8: 1L,2M,3M & 1M,3L,2L: STC;

This figure is therefore called with dancers 1L,2M,3M and 1M,3L,2L. On bars 19 and 20, corresponding to the line from the definition of STC, the dancers are first woman and second man, and first man and third woman. This also illustrates that order is important when specifying dancers.

A figure is specified by either the name or the short name of either a defined figure or a built in atomic figure. This may be followed by a list of parameters separated by commas and with the whole list enclosed in round brackets.

The parameters may be either numbers or one of the following special parameters:

LH, RH and BH: These signify left hand, right hand and both hands respectively. These parameters are used in turns, for example.

LS and RS: These, used in reels and when two people pass, indicate left or right shoulder.

PH and AH: These signify promenade and allemande hold respectively.

NH: This is used to show no hands should be given when crossing, for instance.

NR or NRH This shows the dancers give nearer hands, in a lead down the middle and back, for instance.

X and C plus U, D or O: These signify a cross or a cast to start (eg) a figure of eight. Followed by U means “up” while a D or an O means “down”.

In the definition of the Duke of Perth, we have

17,8: 1L,2M,3M & 1M,3L,2L: STC;

25,6: 1L,2M,3M & 1M,3L,2L: R(3,LS,100);

The first figure is STC, the set and turn corners figure defined later in the file. This has no parameters. The second figure is R(3,LS,100). This is a reel. Looking at the specification of the reel (which is an atomic figure) the parameters show it is a reel of three, starting with the dancing person giving left shoulder, and is a full reel, 100%.

Note that a figure may be referred to before it has been defined, as in the sample file with the CP and STC figures. As a result of the mechanism for this the program will also accept references to undefined figures. When the dance is animated such figures are ignored.

4.4 Comments

Notice the comment forms used throughout. There are two types: a single line comment, started using % and running to the end of the line, and a comment which can span multiple lines and is started and finished by %%. Comments can start at any point on a line or within the file. They can even occur in the middle of tokens. Both types appear in the sample file.

The layout of the file is also unimportant. The sample file has been laid out with one subfigure to a line, but this is not necessary. Several subfigures may be given on one line, or a subfigure may be split over several lines, or whatever.

5. The file format—formal definition

This chapter gives the syntax and intended semantics of the file format in a rigorous fashion. The complete syntax is given in BNF, and then the semantics of each syntactical element is described in detail.

5.1 The syntax

The syntax is given in a slightly extended version of Backus-Naur form. Non-terminal tokens are indicated as follows: *token*, and terminal tokens as here: ‘**token**’. A definition is of the form *non-terminal* \rightarrow *token-list*. Where one non-terminal token has several possible derivations they are indicated by *derivation1* | *derivation2* | ... All terminal tokens are case-insensitive. Where there are several mutually-exclusive single-character tokens these are indicated using [‘*token-list*’]. Here the *token-list* contains single characters and/or ranges of characters marked by *start–finish*. If it starts with ^ all characters are valid *except* those listed. \n, \r and \t are used for the new-line, carriage-return and tab characters, following the C convention. So for instance the digits are represented by [‘0–9’], and everything except a new-line and a tab would be represented by [‘^\n\t’]. The end-of-file character is represented by ‘<EOF>’, and the symbol ε is used to represent the empty token. The shorthand (*tokens*)? will be used to denote zero or one occurrences of the token or bracketed group of tokens. Similarly (*tokens*)* will be used to denote zero or more occurrences, and (*tokens*)+ to denote one or more occurrences.

5.2 The semantics

This section takes each syntactical element in turn and outlines the intended meaning.

All angles used in this section will be expressed in degrees, as is used in the files. This particularly applies to *f* coordinates.

5.2.1 Terminal characters

$$alpha \rightarrow [‘A-Z’] \tag{1}$$

$$digit \rightarrow [‘0-9’] \tag{2}$$

$$punctuation \rightarrow [‘, . ; : " ? ! ’] \tag{3}$$

$$wschar \rightarrow [‘ \t \n \r ’] \tag{4}$$

The terminal characters from which lexical elements are built up fall into four categories: letters (1), digits (2), punctuation (3) and whitespace characters—space, new-line, carriage return and tab. Note that letters are case insensitive: “c” and “C” are equivalent at all times.

5.2.2 Comments

$$comment \rightarrow line-comment \mid block-comment \mid \varepsilon \tag{1}$$

$$line-comment \rightarrow ‘%’ ([‘^\n’] ([‘^\n\r’])*?) \tag{2}$$

point numbers consist of an optional negative sign, followed by zero or more digits, followed by a full stop to signify the decimal point, followed by zero or more further digits giving the fractional part. If the part preceding the decimal point is missed out it is taken to be zero. Integral numbers ((2) and (3)) may be given in place of floating point numbers but not the other way round.

5.2.6 The file and figure definitions

$$\text{dance-file} \rightarrow (\text{figure-definition})^* \langle \text{EOF} \rangle \tag{1}$$

$$\text{figure-definition} \rightarrow \$ \text{figure-names} (\text{dance-details})? \$ \text{start-setup} \$ (\text{figure})^* \$ \tag{2}$$

$$\text{dance-details} \rightarrow \backslash (\text{source})? \backslash \text{type} (+ \text{type})^* \backslash (\text{tunes})? \tag{3}$$

$$\text{source} \rightarrow \text{punctuation-string} \tag{4}$$

$$\text{type} \rightarrow \text{number} \text{X} \text{number} [\text{RJS}] \tag{5}$$

$$\text{tunes} \rightarrow \text{punctuation-string} \tag{6}$$

A file (1) contains a series of zero or more figure definitions (2), with the end-of-file character marking the end of the file. These definitions start with a '\$' character, followed by the names of the figure as described in section 5.2.7. The dance details then follow as described below. Note that these are optional as they only make sense for a figure which is also a complete dance. Another '\$' character is followed the initial configuration as described in section 5.2.8 and then yet another '\$' character. The description of the component figures (section 5.2.11) is followed by a final '\$'.

If the extra details are given they consist of the source, dance type and tunes, each preceded by a '\'. The only detail which must be provided (if any are provided) is the type.

The source is either who devised the dance or where it was found. This can be a *punctuation-string* as described in section 5.2.4, or empty.

The dance type consists of a number indicating how many times the dance is repeated, an 'X', and 'R', 'J', 'S' or 'H' signifying a reel, jig, strathspey or hornpipe respectively. For a medley this may be followed by a '+' and another type. This may be continued up to 10 times.

5.2.7 Naming figures

$$\text{figure-names} \rightarrow \text{figure-name} (, \text{short-name})? \tag{1}$$

$$\text{figure-name} \rightarrow \text{space-string} \tag{2}$$

$$\text{short-name} \rightarrow \text{space-string} \tag{3}$$

Since a figure name is delimited by a '\$' and either a '\' or another '\$' (5.2.6, 5.2.6) the string used for its name can contain spaces. The person writing the dance may also specify a shortened form, separating the two with a comma. The figure name may be up to 50 characters long, and the shortened form up to 10.

5.2.8 The initial configuration of the dancers

$$\begin{aligned} \textit{start-setup} &\rightarrow \textit{number-participants} \text{ ':' } (\textit{position})^* \\ &| \textit{digit} \text{ 'C' } \textit{set-type} \end{aligned} \tag{1}$$

$$\textit{number-participants} \rightarrow \textit{number} \tag{2}$$

The initial configuration of the dancers is given in either of two forms:

1. A number of dancers, followed by a colon, followed by a list of starting positions (section 5.2.10). Care must be taken to ensure that the number of positions specified corresponds to the number of dancers stated.
2. A standard set type. This is given by a number of couples followed by a 'C', followed by a type of set, as described in section 5.2.9.

5.2.9 The sets

$$\textit{set-type} \rightarrow \textit{longwise-set} | \textit{square-set} \tag{1}$$

$$\textit{longwise-set} \rightarrow \text{'LS'} | \text{'LongwiseSet'} \tag{2}$$

$$\begin{aligned} \textit{square-set} &\rightarrow \text{'TS'} | \text{'TriangularSet'} | \text{'SQ'} | \text{'SQS'} | \text{'SquareSet'} | \text{'HX'} | \text{'HXS'} | \\ &\text{'HexagonalSet'} | \text{'CircularSet'} \end{aligned} \tag{3}$$

The standard sets are either longwise or circular. Longwise sets are indicated by 'LongwiseSet', or 'LS' for short. Remember that the parser makes no case distinctions, and hence 'longWiSeSet' (for example) is equally valid.

Circular sets may be indicated in several ways, reflecting the different shapes such sets form. Three couples in a circle form a triangle, four form a square and six form a hexagon. These are the most commonly used such formations. Accordingly 'TriangularSet' (or 'TS'), 'SquareSet' (or 'SQ' or 'SQS') or 'HexagonalSet' (or 'HX' or 'HXS') may be used. The generic term 'CircularSet' may also be used. Note that, with the exceptions outlined below, the program makes no distinction between any of these, so a '7CTriangularSet', a '7CHexagonalSet' and a '7CCircularSet' all result in seven couples evenly spaced around the perimeter of a circle.

The exception is the SquareSet. There are various forms of square sets for more than four couples, and the program will try to reflect this. A '5CSquareSet' or a '6CSquareSet' will produce a square set with the extra couple(s) in the centre, as in, for instance, Gavin's Reel [2]. A square set with a multiple of four couples, will have the couples arranged equally along four sides. So an '8CSquareSet' as in the *Sixteensome Reel* would have two couples on each side, a '12CSquareSet' would have three couples on each side, and so on.

Note that these terms contain no spaces.

In actual fact only the first three letters of the set type are significant, and so any truncation to three letters or longer is accepted.

5.2.10 Positions

$$\textit{position} \rightarrow \textit{relative-position} | \textit{absolute-position} \tag{1}$$

$$\textit{relative-position} \rightarrow \text{'\#'} \textit{dancer} \textit{absolute-position} | \text{'@'} \textit{dancer} \textit{absolute-position} \tag{2}$$

$$\text{absolute-position} \rightarrow \text{'(' signed-number (',' signed-number (',' signed-number)?)? '}' \quad (3)$$

Positions may be relative or absolute.

An absolute position is enclosed in round brackets '(' and ')'. The devisor may give only the x -coordinate, the x - and y -coordinates or all three coordinates, with the f -coordinate as well. Coordinates are signed numbers (section 5.2.5) separated by commas and, optionally, whitespace. Unspecified coordinates are taken to be 0. So '(100,0,0)', '(100,0)' and '(100)' are identical.

Relative positions have exactly the same syntax as absolute positions, with the addition of either a '#' or an '@' symbol and a dancer (section 5.2.14) at the front, optionally separated from the absolute component with whitespace.

The '#' forms are evaluated by adding the absolute coordinates to the coordinates of the location of the given dancer at the time of evaluation, while the '@' forms are calculated with respect to the dancer's original position. So if second man in a longwise set is at location (250, 0, 0), '#2M(-50, 50)' gives (200, 50, 0). '@2M(-50, 50)', on the other hand, gives (150, -50, 90), since second man started the dance in second man's place (surprisingly enough)—(200, -100, 90).

5.2.11 The component figures

$$\text{figure} \rightarrow \text{start ',' duration ':' dancers ([',&'] dancers)* ':' subfigure ':' (relative-position)* ';' \quad (1)$$

$$\text{subfigure} \rightarrow \text{figure-name ('(' parameter ([',&'] parameter)* ')')? | repeat \quad (2)$$

The component figures which make up a dance consist of an indication of when they occur, followed by a list of dancers and a figure. A list of finishing positions may optionally be appended. The various sections are separated by colons, and may also be surrounded by whitespace.

The time indication gives a starting bar and a duration in bars, separated by a comma. The list of dancers is described in section 5.2.14.

The description of the figure consists of a figure name, either the full or the shortened version, optionally followed by parameters to the figure (section 5.2.12) in round brackets. Alternatively a repeat may be specified, as described in section 5.2.13. Note that a figure may be referred to before it has been defined, and it is even possible to include figures which are not defined. Undefined figures are treated as composite figures with no subfigures in animations, and hence have no effect.

The optional position list is a list of relative positions as described in section 5.2.10, optionally separated by whitespace, although since positions are terminated by a closing brace this is not necessary. It gives the positions of the dancers involved in the figure when the figure finishes. The first position corresponds to the first dancer, the second to the second, and so on. It is not necessary to specify a final position for all the dancers.

5.2.12 Figure parameters

$$\text{parameter} \rightarrow \text{number | 'L' | 'R' | 'B' | 'LH' | 'RH' | 'BH' | 'LS' | 'RS' | 'P' | 'A' | 'PH' | 'AH' | 'N' | 'NH' | 'NHL' | 'NHR' | 'NR' | 'NRH' | 'XU' | 'XD' | 'CU' | 'CD' | 'CO'} \quad (1)$$

The parameters to a figure are enclosed in round brackets (section 5.2.11). They are given as a comma-separated list.

A parameter may be either a number (section 5.2.5) or one of the strings below:

‘L’, ‘R’ and ‘B’ These signify left, right and both respectively. They are most commonly used to represent the hands given in a turn, and may be followed by an **‘H’** in recognition of this. They are also sometimes used to represent the nearer shoulders of two dancers passing, and may be followed by an **S** to show this. Note that **RH** and **RS** are not equivalent, although some figures do treat them so.

‘P’ and ‘A’ These signify promenade and allemande hold respectively, and may be followed by an **H**.

‘N’ This signifies none when followed by an **H** or alone, and nearer when followed by an **R** (see below). It is used to specify that the dancers should not give hands when crossing over, for instance. It may be followed by an **H** and a **R** or an **L** to show that the dancers should pass by the right or left shoulder respectively.

NR This signifies nearer, as in nearer hands. It may be followed by an **H**. It is used to show that the dancers should give nearer hands in a lead down the middle and back, for instance.

‘X’ and ‘C’ + ‘U’, ‘D’ or ‘O’ These represent crossing or casting. The second letter specifies whether it is up (**‘U’**) or down, also referred to as *off* for a cast (**‘D’**, **‘O’**). These are used in figures of eight to specify how the dancers should start the figure.

5.2.13 Repeats

repeat → **‘RPT’** | **‘REPEAT’** (1)

A repeat starts with one of the repeat markers **‘REPEAT’** or, more succinctly, **‘RPT’**. It indicates that the figure to be performed is the same as that given in the previous figure. Note that here previous figure means previous in the file and not in time.

5.2.14 List of dancers

dancers → *number* **‘C’** | *dancer* (1)

dancer → *number* [**‘MLW’**] | **‘#’** *number* (2)

A list of dancers may be separated by commas and/or ampersands. This is to allow the devisor to highlight their grouping. The program makes no distinction between the two separators.

A dancer is given by either a number, followed by **‘M’**, signifying a man, **‘W’** or **‘L’**, signifying a woman, or **‘C’**, sigifying a couple. Alternatively she may be specified using the form **‘#’** followed by a number. This means the dancer with the same internal number as that given, starting at 1. In fact **‘1L’** is expanded internally to **‘#1’**, **‘1M’** to **‘#2’**, **‘2L’** to **‘#3’**, and so on. **‘1C’** is expanded to **‘1M,1L’** which is expanded to **‘#1,#2’**, and similarly for the other couples. Note that the dancer specified as part of a relative position (section 5.2.10) may not be a couple.

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