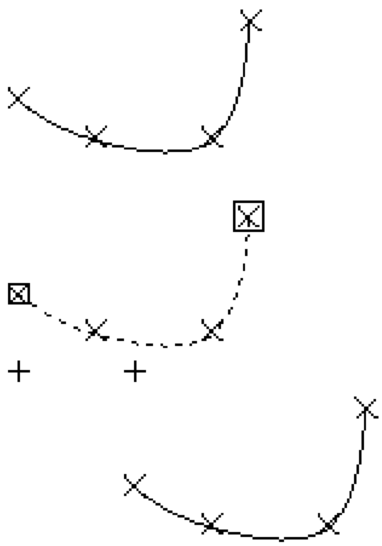
4. Transformations

Splines curves may also be modified with several transformation operations: *move*, *copy* and *drag*. These operations all apply to a section of a curve.

4.1 *Move*:

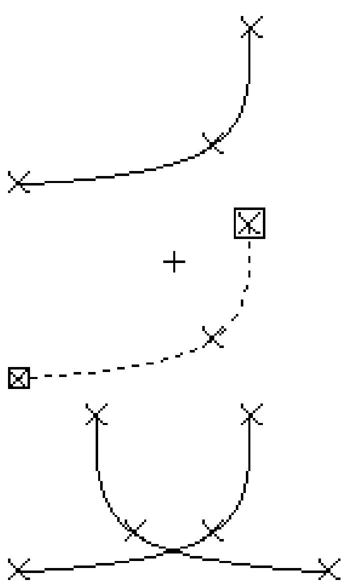
1
2
3



This command does one of three geometrical transformations on a curve section: a translation, a vertical symmetry or a horizontal symmetry. First specify a curve section (see above: 3.4). Then point at one of the three options of the command *move*: *translation*, *horizontal symmetry*, *vertical symmetry*. Then the editor goes into a mode identical to knot input mode (see above: 3.2). However only one or two points are specified. They define the geometrical parameters of the transformation. For a *translation*, define the origin point and the destination point (this is illustrated on the left). For a *horizontal symmetry*, define one point on the horizontal axis of symmetry; For a *vertical symmetry*, define one point on the vertical axis of symmetry (this is illustrated below, in the context of a copy command).

4.2 *Copy*:

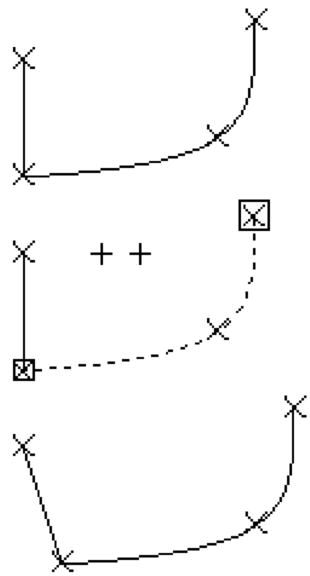
1
2
3



This command makes a transformed copy of a curve section. It is otherwise the same as the *move* command. The illustration on the left demonstrates *vertical symmetry*.

4.3 **Drag**:

1
2
3



This is a version of the command **move** (translate) in which all the curves sharing the knots of the translated curve section are modified accordingly. Knots common to several curves, such as end knots of connected curves, may thus be translated in one single operation.

4.4 **Repeat**:

This command will repeat the most recently applied transformation (**move**, **copy** or **drag**) to the current selection with the same parameter (i.e. same translation vector or same symetry center).

4.5 Simple combinations:

Deleting a knot, a curve or a portion of a curve is easily done by executing a **replace** and then a **do it** without supplying a set of new knots.

Moving a single knot can be done in two ways: **replace** or **move**.

Inserting N new knots between two consecutive knots k_1 and k_2 is done with a **replace**: select k_1 and k_2 respectively as the end knots of a section; then input N+2 points such that point 1 coincides with k_1 (using switch 2), points 2 to N+1 are the N new knots, point N+2 coincides with k_2 (using switch 2).

Appending N new knots at either end of a curve is done in a similar way: select the end knot as a single knot section, and **replace** it by N+1 new knots. However, be aware of the ambiguity associated with single knot sections (3.5).

5. Other operations on spline curves

5.1 *Wipe*:

This operation deletes all displayed curves. Beware: no confirmation is expected. An accidental *wipe* may be recovered from with the *undo* command (5.2). A *wipe* is actually equivalent to a succession of single curve deletions. Therefore it will take an equal number of successive *undo* operations to recreate all the deleted curves.

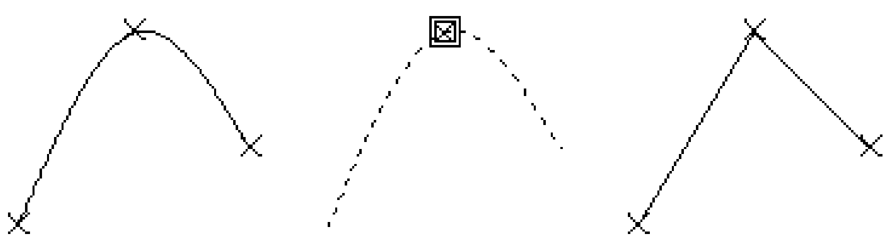
5.2 *Undo*:

Spline curves are created, go through a history of modifications, and may eventually be deleted. The *undo* feature is provided for recovering from destructive events in the history of curves, that is modifications and deletions. It applies to the operations *replace*, *remove*, and *wipe*. It does not apply to other types of operations (i.e. *make*, *copy*, *break* and *join*), since they are easily invertible.

All deleted curves and all modified curves are chronologically "remembered," up to some finite variable depth. The most recently deleted or modified curve is recreated when the command *undo* is invoked. If that curve had originally been modified (through a *replace* or *move*), the curve that was substituted for it disappears permanently. The depth of "memory" is variable, because it is a function of the internal storage available to the spline editor. The "memory" will be expunged of its oldest items according to these requirements. It is believed that if FRED is not used extravagantly, the depth of "memory" is about a dozen items. Immediately after a *wipe*, all deleted curves should be recoverable.

5.3 *Break*:

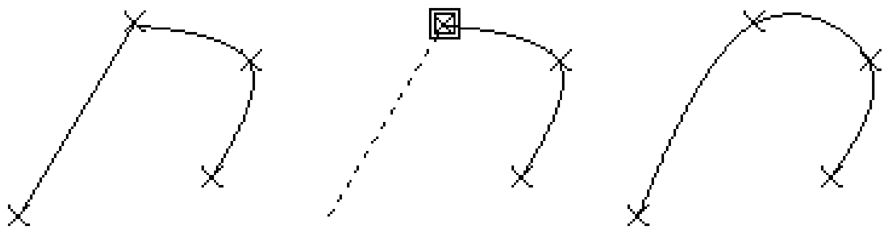
This operation is used to break one single curve into two connected curves. First select the knot where the "breaking" is to happen, and then execute this command.



1 2 3

5.4 J o i n:

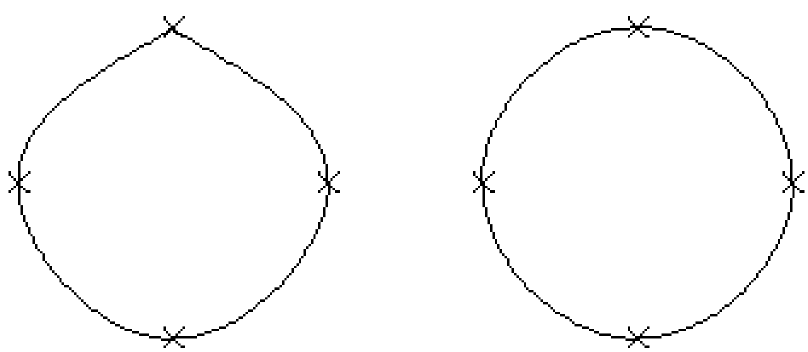
This is the inverse of the b r e a k operation. First select the common end knot of two connected curves, and then execute the command. The two connected curves are joined into one single smooth curve. The command is not executed if there is ambiguity, namely if there are more than two curves with the same end knot.



1 2 3

5.5 Cyclic curves:

The j o i n operation may also be applied to a closed curve. This will produce a cyclic curve with a smooth junction. A cyclic curve does not have any end points. It may be broken at any of its knots.



closed cyclic