

Towards a Taxonomy of Manoeuvre: Part 1

Michael Ketemer with thanks to Doug Gifford for suggestions and graphics.

Since the object of Canadian style paddling is the performance of manoeuvres, two questions come to mind - how many types of manoeuvre are there, and how may they be classified? These are not idle questions. An examination of the taxonomy of manoeuvre has implications for the terminology used to describe manoeuvre and communicate about it. Most importantly, classification of manoeuvres by their geometry provides an analytical tool for the paddler: the geometry of a manoeuvre determines the options available for application of forces to effect that manoeuvre.

This is important since perhaps the single major cause of difficulty in learning to perform a manoeuvre is the failure to visualize in one's mind's eye a clearly defined image of the pattern of movement of the canoe. It is important to use easily understood, yet precise and unambiguous terms to describe a boat's motion when teaching, and especially when arguing technique with other paddlers. Another benefit of this kind of study is that it can be seen that there are several advanced manoeuvres which no-one to the author's knowledge has yet performed, because there was no easy and systematic way to conceive of them.

The Manoeuvre

A hierarchical taxonomy of manoeuvre must firstly define manoeuvre as a subset of all possible activities performable by a canoeist. Besides the manoeuvre, which is defined in terms of the movement of a canoe-shaped figure on the waterplane, there are other possible classes of things to do in a canoe: pastimes such as sleeping, courtship, break dancing or diamond cutting; and stunts, which include gunwale bobbing, thwart jumping, handstands on the thwart, Eskimo rolling and the like. Although these are valid uses of the recreational canoe, pastimes and stunts, however well executed, should not be confused with the manoeuvre, which is the object of Canadian flatwater Canadian style paddling. Paddlers who think that a one-handed handstand on the bow deck is an impressive demonstration of ability are right: but is it paddling? Paddlers should consider that stunts included in performance merely reinforce the popular perception of a canoe as a tippy, poten-

tially hazardous craft. The only way to sensitize others to the beauty of a canoe's movement is to present only the movement of the canoe. It is perhaps best to keep stunts and paddling two separate disciplines for the time being, pending wider acceptance of artsy paddling for its own sake.

What, then, do we mean by 'manoeuvre'? In the real world, there is literally an infinity of possible movements of a canoe on the two-dimensional waterplane, so it would take quite a long time for the ambitious style paddler to perform every possible movement. However, one should most definitely applaud this ambition: the essential attitude of the style paddler is to try to exhaust the possibilities of the canoe for movement.

Fortunately, we can reduce the infinity of possible manoeuvres considerably—in fact, to thirteen. By abstracting we can define classes of manoeuvres which share the same type of motion. An example is the circle turn: it doesn't matter whether the circle is ten metres or fifty metres in diameter, the geometry of the manoeuvre remains the same (and by extension, the placement and direction of forces required to perform the circles are similar, though their magnitudes will differ). In the same way, if one paddles a canoe diagonally it doesn't matter whether the hull is at an angle of 45 degrees or 60 degrees to the line of travel; each are members of the same class of manoeuvre.

Manoeuvre and Routine

We can reduce the number of possible manoeuvres considerably by recognizing that manoeuvres can be linked to form routines. For instance, a S-turn is a compound manoeuvre comprised of an inside turn and an outside turn linked. All manoeuvres by definition can continue indefinitely. The transition between manoeuvres is termed the change-up. The notion of the change-up is important in practice, for it is at these points that the paddler must apply a different set of forces on the canoe. Since the state of motionlessness is defined as a manoeuvre, stops can be seen as a species of change-up.

So then, our basic taxonomic unit (taxon) is the manoeuvre. Manoeuvres can be linked by change-ups to form routines.

Manoeuvre Definitions

All manoeuvres can be defined in terms of the following distinctions:

1. Does the pivot point move?
2. If the pivot point moves, is the path of the pivot point curved? Note that if the path curves, further differentiation of the curves could occur at a lower taxonomic level (e.g., spiral, cycloid, parabola, hyperbola, etc.), but these taxa would define only the rate of curvature as a new variable.
3. Does the canoe rotate around the pivot point? Geometrically, the question is expressed: is the manoeuvre a translation (every point of the canoe moves through the waterplane an equal distance in the same direction) or is the motion angular (not all points of the canoe travel equal distances, i.e., the canoe rotates during the manoeuvre)?
4. Does the pivot rate equal the curve rate? This differentiates between straight lines and line pivots (no curve and some pivot), curve turns and curve translations (some curve and no pivot) and curve turns and curve pivots (where the canoe is pivoting at a different rate than it is curving).

By examining the combinations of the cases given above, a table of all possible manoeuvres can be developed. All of the distinctions can be expressed as a binary opposition; either the characteristic is there or else it isn't. Thus we derive seven basic manoeuvres: stationary, pivot, straight line, line pivot, curve translation, curve turn, curve pivot.

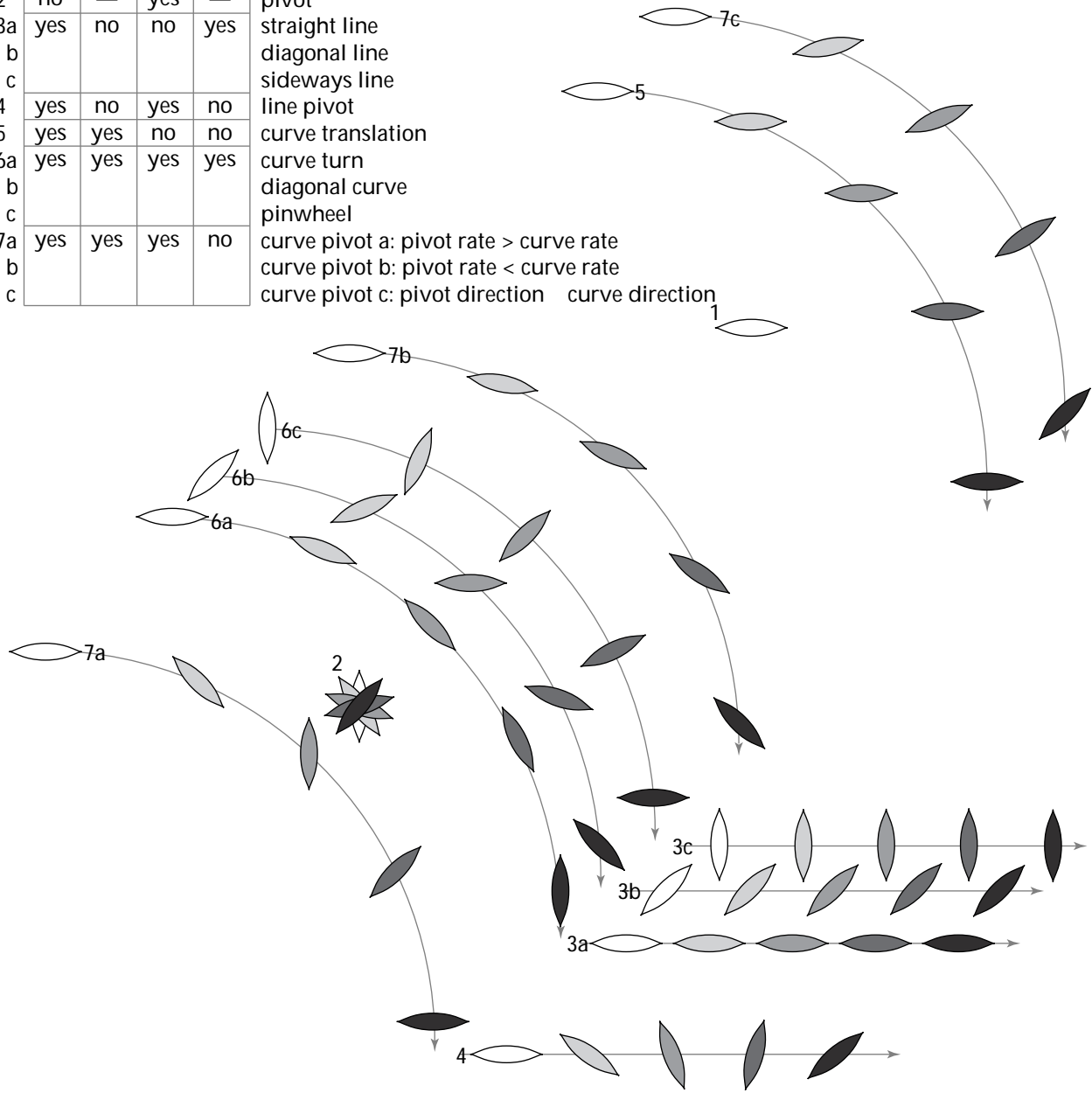
In addition, we can further divide the line and curve by the angle of the boat relative to its direction of travel and the curve pivot by the relation of its pivot to its curve for a total of thirteen theoretically possible manoeuvres. Figure 1 shows the binary table and illustrations of the thirteen basic manoeuvres.

Note that this terminology differs from standard ORCA usage, but is much more logical (ORCA terminology has some glitches: why is going sideways called a displacement, and other movements are not? Why is there no actual turn in a stop turn as defined by ORCA?).

So far we have covered the motion of an idealized canoe on a flat surface. In part two we will add a paddler.

Solo Canoe Manoeuvres

	Does the pivot point move?	Is the path curved?	Does the boat pivot?	Does the pivot rate equal the curve rate?	
1	no	—	no	—	stationary
2	no	—	yes	—	pivot
3a	yes	no	no	yes	straight line
b					diagonal line
c					sideways line
4	yes	no	yes	no	line pivot
5	yes	yes	no	no	curve translation
6a	yes	yes	yes	yes	curve turn
b					diagonal curve
c					pinwheel
7a	yes	yes	yes	no	curve pivot a: pivot rate > curve rate
b					curve pivot b: pivot rate < curve rate
c					curve pivot c: pivot direction = curve direction



Towards a Taxonomy of Manoeuvre: Part 2

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Last issue we dealt with the movements of an idealized canoe shape on a plane. By working through a binary table of possibilities, we came up with thirteen basic manoeuvres.

By placing a paddler in the canoe, several other directional descriptors can be generated to describe the motion of the canoe in terms of the paddler's orientation in the boat. The use of these terms is rationalized by the fact that a canoe shape viewed in plan is organized around two axes, the centreline and a transverse axis which divides the canoe in fore and aft. Putting a paddler amidships gives us terms for the motion of the canoe which can be stated in terms relative to the paddler's body, which displays analogous organization into quarters (anterior/posterior and left and right) when viewed in plan.

The two pairs of descriptors which categorize manoeuvre in terms of the paddler's orientation are

forward/backward and inside/outside. Forward and backward are easily grasped descriptors. Inside and outside can refer to three things. They can refer to the paddler's side in linear motion—if the paddler is moving the canoe in the direction of his/her paddling side, that motion is termed an inside sideways line. Inside and outside also refer to the paddler's paddling side in a curve: if the paddler is doing a circle with his/her paddling side on the inside of the circle, then that circle is termed an inside curve turn. Pivoting so that one's bow rotates towards one's paddling side is termed an inside pivot.

Application of these descriptors will define a number of subclasses of each of the basic thirteen manoeuvres, with the several directions relative to the paddler in which the manoeuvre can be performed. For instance, one can paddle a canoe in a straight line forward or backward; a circle turn can be inside forward, inside backward, outside

forward and outside backward. To specify a manoeuvre in the real world, the use of the full manoeuvre definition (e.g. inside line pivot) is required.

The thirty-seven subclasses generated by the application of these descriptors to the basic thirteen classes are illustrated below and on the next page.

Any manoeuvre can move into any other through a change-up. By combining manoeuvres, we can construct routines.

Note that all "manoeuvres" previously defined in the literature are subsumed under these subclasses (e.g., what the rest of the world calls a stop turn under this schema is a line pivot that changes up to a stop), and that there are several manoeuvres which have not—to my knowledge—previously been defined or attempted (the curve pivot).

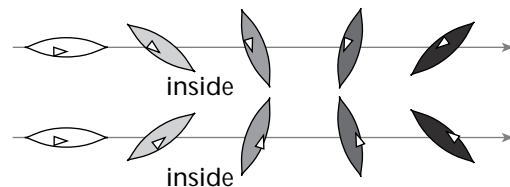
1: stationary



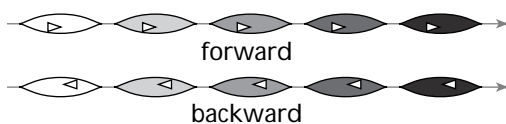
2: pivot



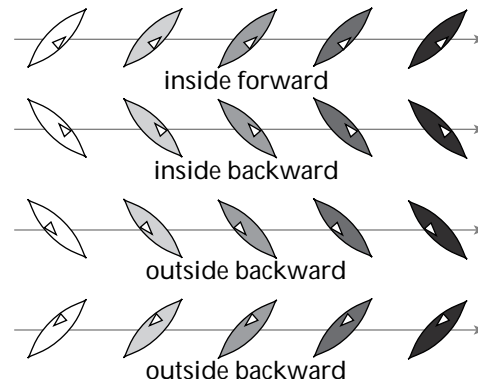
4: line pivot



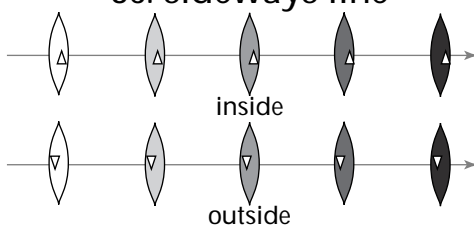
3a: straight line



3b: diagonal line



3c: sideways line



Solo Canoe Manoeuvres: Curves

