DECISIVE PERTURBATION MECHANISM IN RUGBY UNION

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Introduction The perturbation structure in the match situations would occur in some decisive momentum. As the interaction with many players' physical contest and continuity, the mechanism would be made by multidimensional factors in the offensive and defensive commitment. The random-walk movement analysis would be one start the discussion of the complex system.

Methods The perturbation of plus (+) , minus (-), or no-move (zero:0) are accumulated based on the vertical axis. The horizontal axis shows time series. The ratio of plus (+) is 'p', minus (-) is 'q', and no-move 'r' is (0), then 'p + q + r = 1'. At the time of 't' on place of 'x', the ratio variance of the move is v(x, t), then, the equation is shown as, " $v(x, t+\tau) = pv(x-\delta, t) + qv(x+\delta, t) + rv(x, t)$", (v:present position after perturbation). It shows the position 'v' at time 't+τ' on the place 'x' is the result from 'p' ratio move up from 'v' at time 't' on 'x-δ' , 'q' ratio move down from 'v' at time 't' on 'x+δ', and 'r' ratio no-move. Moving one unit (δ) of perturbation is defined one same distance manipulated. The plus perturbation items are concerned with ball contest/possession (getting kick-off, scrum, lineout, pant catch, even-ball, intercept, turn-over) and with play continuity (pass, ruck/maul, line-break-running, line-break-kicking). The minus perturbation items are the same ones of the opposite. The tracking-line of perturbation shows the process of contest and continuity situation which has been said as the key feature of Rugby Union (IRB, 2010). And it also show the accumulation volume (S) of the comparative advantage (or disadvantage) of the contest and continuity in the match.

$S = \int^{+} f(t)dt$ (:f(t) is the actual position of the perturbation in the match)

Results & Discussion

The results of the perturbation process shown with the point-balance of the match suggested the point balance might move in relation to the perturbations. For the confirming the relation, the sum of perturbations on the time series (0 to 80 minutes) was compared with value of the final point-balance of the competed seven games (closed world ranking between 11th to 16th). The relation of sum of perturbation and point-balance were related significantly (Spearman's rank correlation coefficient=0.93, $P<.05$) and the marginal perturbation values for winning was the value more than 1,000 perturbations. In the match situation, the decisive perturbation mechanism should be verifying.

The turnover in defense and line-break in offense were selected to be the contribution factors. The partial correlations between line-break, turnover, and perturbations with the final point balance were calculated. Line break (0.71, $p<.01$) and perturbations (0.63, $p<.01$) had significantly relation with point balance and those were suggested the decisive perturbation factors.