# Effect of stroke rates on hand-curve during rowing

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# 1. Introduction

On rowing boat, hand-curve is correlated with the blade trajectory. Therefore, the hand-curve is a performance parameter in this sport (Nolte 1991). It's the result of a spatiotemporal organisation of the rower gesture. Thus, all variations in rower coordination could affect its modification. Découfour and Pudlo (2004) have shown that even an international rower modifies his coordination on ergometer when stroke rate increase. What happened on hand-curve? Does it change too? Can we identify good and not so good rowers on ergometer? This paper aims at give a first answer to these questions.

### 2. Materials and methods

The experimentations have been realized with nine national rowers (at least finalists in French championship) on 'concept II' ergometer. Among these rowers, there is an international Algerian rower who won several times French championship in double scull. Every subject rows at different rates: 18, 20, 24, 28, 32, 36 and 40 strokes per minute. Every stage must be maintained during 15-20 s according to the difficulty. Between every stage, the rowers have a break during 2 min. For each stroke rate, they have to row with a power which fit them, for example, at 28 strokes min<sup>-1</sup> they maintain a power around 200 W.



The rower's motion is recorded with the motion analysis system Vicon.

Hand-curve is specified in the sagittal plan. Three parameters will be taken from hand-curve: anteroposterior amplitude and vertical amplitude like Burnett *et al.* (2004) defined them and the 'A' area bounded by hand-curve (figure 1).

## 3. Results

Figure 2 shows the mean evolutions of hand-curve anteroposterior and vertical amplitudes for each imposed



Figure 2. Anteroposterior (a) and vertical (b) amplitudes for each stroke rate.

Computer Methods in Biomechanics and Biomedical Engineering ISSN 1025-5842 print/ISSN 1476-8259 online © 2005 Taylor & Francis http://www.tandf.co.uk/journals DOI: 10.1080/10255840512331388290



Figure 3. Evolution area 'A' in each rower.

Table 1.	Correlations	between	amplitudes	and areas.

	Anteroposterior and vertical Amplitudes	Antereoposterior Amplitude and Area	Vertical Amplitude and Area
Rower 1	0.86	0.89	0.97
Rower 2	0.95	0.84	0.94
Rower 3	0.94	0.89	0.97
Rower 4	0.87	0.90	0.99
Rower 5	0.88	0.93	0.96
Rower 6	0.75	0.96	0.85
Rower 7	0.76	0.58	0.92
Rower 8	0.65	0.88	0.93
Rower 9	0.95	0.99	0.98

stroke rate. Figure 3 presents area 'A' evolution according to rates for each rower. Table 1 shows coefficient of

correlation between amplitudes and area 'A' for each rower.

For all rowers, amplitudes and areas of hand-curves decrease when imposed cadence increases. Each computed correlation between amplitudes and area is up than 0.95 for only one rower: The international Algerian, the rower 9.

#### 4. Conclusion and perspective

Rowers modify their hand-curves when stroke rate increase as well amplitudes as area 'A'. Only the international rower have a correlation coefficient above 0.95 between each parameters of this study. Hand-curve described by this rower ergometer handle could undergo homogeneous reduction in the sagittal plan. Our future studies aim at describe form variations of the hand-curve at different stroke rates to conclude on this hypothesis.

### References

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