SUMMARY
Butterfly stroke is a unique swimming style and has been considered as the most difficult swimming style to perform because of the synchronizing characteristics of the arm and leg movements. The aim of this study was to examine the relationship between arm – leg coordination and different stroke phase in the butterfly stroke. Two underwater high-speed cameras (200 Hz) were set in the transaction and sagittal plane under the water and synchronized to capture the swimming movement. The kinematics data were digitized and calculated with the Kwon 3D software. The peak velocity occurred in the end of the pull phase coincided with the continuous relative phase had the in-phase pattern. (see Figure 1). And the result has also corresponded to Chollet (2006) that the arm to leg coordination get closer to the in-phase mode at particular duration was reflect the skill of butterfly swimming. The results might had an indirect evidence to prove that arm and leg coordination has a highly relation to the horizontal velocity. This suggests that coaches and swimmers should monitor the arm to leg coordination. Future studies could describe the functions of arm and leg coordination on hydrodynamics mechanism and motor control perspective.

RESULTS AND DISCUSSION
The data of the time and the velocity and distance in each phase are shown in Table 1. In catch phase, the duration was 0.21±0.01 and was about one of fifth. Moreover, it is the same situation in the pull and push phase. In the recovery phase, the duration was 0.39±0.01 and had the longest horizontal displacement in four phases.

In this study, there had two similar graphic in the opposite direction in the velocity and continuous relative phase data. For the forward velocity of one stroke cycle is not constant. The peak velocity occurred in the end of the pull phase coincided with the continuous relative phase had the in-phase pattern. (see Figure 1). And the result has also corresponded to Chollet (2006) that the arm to leg coordination get closer to the in-phase mode at particular duration was reflect the skill of butterfly swimming.

CONCLUSIONS
In conclusion, the velocity of one stroke butterfly cycle has a fluctuation pattern. Each of the catch, pull, and push phase account for one for fifth of whole cycle. Finally, the horizontal velocity of one cycle butterfly stroke is mutative. The peak velocity was occur in the end of the pull phase where can found the continuous relative phase mode highly consistency in this swimmers. Base on this study, the velocity and continuous relative phase data had a similar but opposite pattern. It might had an indirect evidence to prove that arm and leg coordination has a highly relation to the horizontal velocity. This suggests that coaches and swimmers should monitor the arm to leg coordination.
Future studies could describe the functions of arm and leg coordination on hydrodynamics mechanism and motor control perspective.

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REFERENCES

| Table 1: The experiment data in four different phases in butterfly swimming |
|---------------------------------|----------------|---------------|----------------|-----------------|----------------|
|                                 | Catch phase | Pull phase    | Push phase     | Recovery phase  | Total           |
| Time (s)                        | 0.21±0.01   | 0.23±0.03     | 0.19±0.01      | 0.39±0.01       | 1.02±0.04       |
| Percentage (%)                  | 21±1        | 23±2          | 19±1           | 38±1            | 100             |
| Distance (M)                    | 0.34±0.01   | 0.36±0.02     | 0.36±0.01      | 0.51±0.02       | 1.57±0.03       |

Figure 1: The experiment data of continuous relative phase and velocity in the catch, pull and push phase.