Supplementary Material

1 SUPPLEMENTARY DATA

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2 SUPPLEMENTARY TABLES AND FIGURES

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2.1 Figures

Figure S1. Conceptual diagram of the wave glider: It consists of float, cable, and glider.
Figure S2. Example of one CFD simulation results: It can be seen that the thrust generated by the foil under the impact of water flow converges to the accurate value after a while.

Table S1. Sea trial record

|                  | Date      | Time              | Wind | Wave  | voyage |
|------------------|-----------|-------------------|------|-------|--------|
| Trad. Foil       | 2021.05.10| UTC 3:08:39−3:37:58| ~3 kt | 0.2-0.3 m | 190.59 m |
| Asym. Foil       | 2021.05.10| UTC 3:08:38−3:37:09| ~3 kt | 0.2-0.3 m | 201.87 m |

Table S2. Speed estimation of the wave glider

| Trad. peak thrust | Speed-trad. foil | Speed-asym. foil | Speed enhancement |
|-------------------|------------------|------------------|-------------------|
| 20 N              | 0.5462 m/s       | 0.5879 m/s       | 7.6%              |
| 15 N              | 0.4666 m/s       | 0.5022 m/s       | 7.6%              |
| 10 N              | 0.3845 m/s       | 0.4143 m/s       | 7.7%              |
| 5 N               | 0.2743 m/s       | 0.2920 m/s       | 7.7%              |
Figure S3. Experimental control system framework: a host computer, a control board, a motor drive, a motor, a pressure sensor, a signal transmitter, and a power source. In the experiment process, the motion command is sent to the control board through the host computer. After receiving the command, the control board outputs pulse signals with different step sizes to the motor driver according to the command’s content. After receiving the pulse signal, the motor driver will rotate the motor with corresponding steps to achieve speed control. In the process of wave simulation, the output interval of each pulse is different to control the motor to produce different speeds.

Figure S4. Thrust input of the wave glider’s speed estimation. The different thrust produced by asymmetric foil and traditional foil are shown in the figure, obtained from the CFD simulation.
Figure S5. Thrust input of the numeric simulation: The different thrust produced momentum by asymmetric foil and traditional foil are shown in the figure. The total momentum enhancement is also 13.75%.

Figure S6. Glider prototypes: (a) The glider with the traditional foils. (b) The glider with the asymmetric foils.
**Figure S7.** Float prototype: The main control box is equipped with Raspberry Pi with the GPS module and the IMU module. The stabilizer is used to reduce the rolling phenomenon of float.

**Figure S8.** The control system of the prototype: The host processor is a Raspberry Pi board; Powered by a battery; The data collected by GPS module and IMU module is transmitted to the host processor; The host processor and remote computer are connected to a mini router to enter the LAN and communicate. GPS module will send multiple sets of data (GPGGA, GNGGA, GPRMC, GNRMC, ...), all following NEMA 0183 protocol. We only keep the sentence at the beginning of GNRMC (multi-satellite integrated positioning data using GPS, BD2, and QZSS) and eliminate other data. The result of each location information is like "$GNRMC,045355.000,A,2234.4272,N,11432.7194,E,0.96,295.47,260321,,,A*7E". This sentence contains location information such as data header, sensor status, UTC, longitude and latitude, altitude, etc.
Figure S9. Sailing record of the wave glider with traditional foils: From 3:08:39 to 3:37:58; The sailing distance is 190.59 m.
**Figure S10.** Sailing record of the wave glider with asymmetric foils: From 3:08:38 to 3:37:09; The sailing distance is 201.87 m.
Figure S11. Key parameter establishment steps of the asymmetric oscillating foil.