

Supplementary Materials

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1. Design requirements for electromagnetic docking device

Table S1 Design requirements for electromagnetic docking device

Parameter	Requirement
Enveloping Space	less than $\Phi 150\text{mm} \times 30\text{mm}$
Weight	less than 3kg
Power	less than 120W
Electromagnetic Force	greater than 0.12N when the distance is 300mm

2. Design of mandrel diameter of the I-shaped iron core

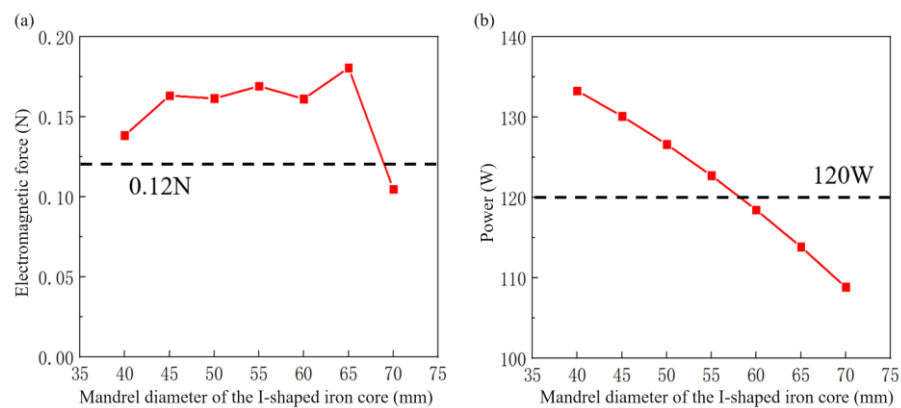


Figure S1 Variation curve of electromagnetic force (a) and power (b) with the mandrel diameter of the I-shaped iron core.

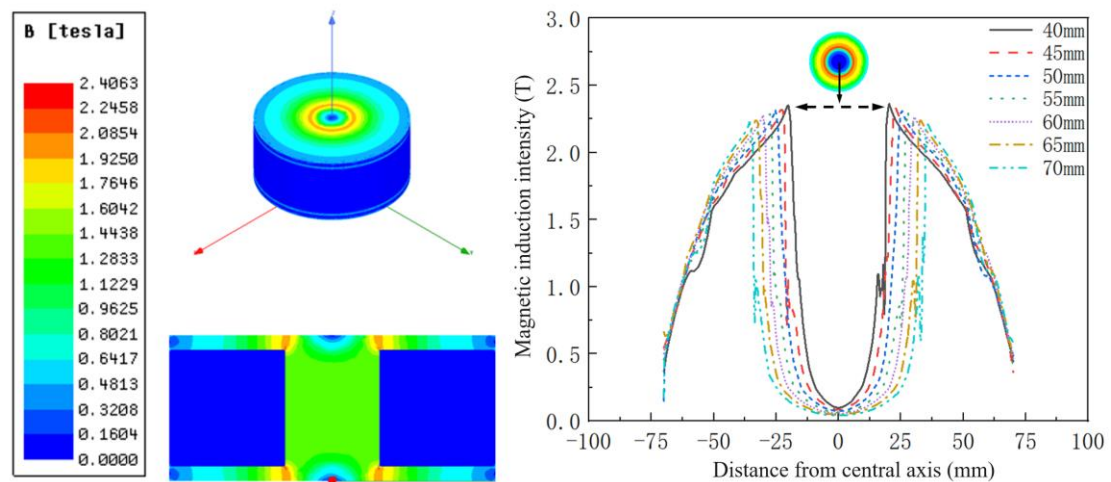


Figure S2 Surface magnetic induction intensity of electromagnetic docking device.

3. Design of the through-hole diameter of I-shaped iron core

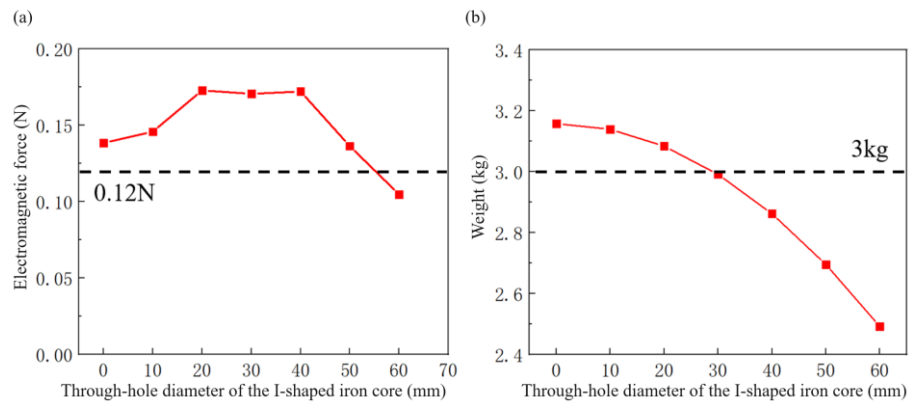


Figure S3 Variation curve of electromagnetic force (a) and weight (b) with the through-hole diameter of the I-shaped iron core.

4. Structural parameters of electromagnetic docking device

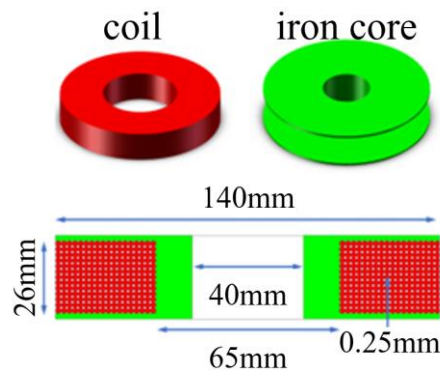


Figure S4 Structural parameters of electromagnetic docking device. The designed electromagnetic docking mechanism requires 3900 ampere turns, 113.8 W power, and a 2.86 kg weight.