

Imagine a world
where your heart
never stops.

Simulator for the Development of Electromagnetic Heart Assist Devices

IOWA STATE UNIVERSITY

Department of Chemical & Biological Engineering

Heart Assist Research Project

Dillon Hurd

120,000

Problem

550,000

New cases of heart failure annually

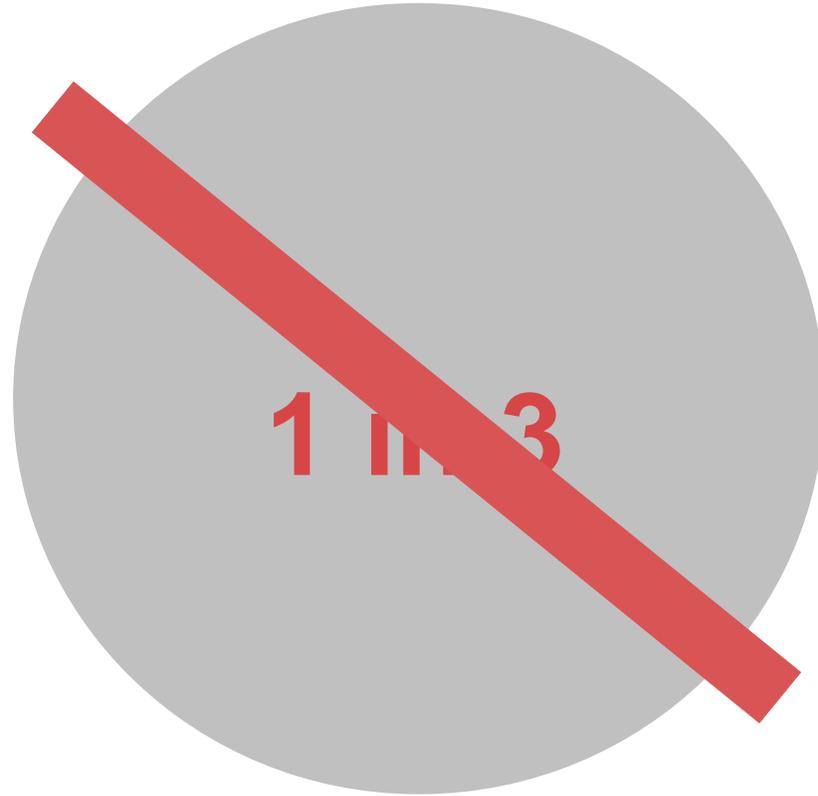
70,000

Heart function
< 40%

8,000

Heart Assist
Device

Problem



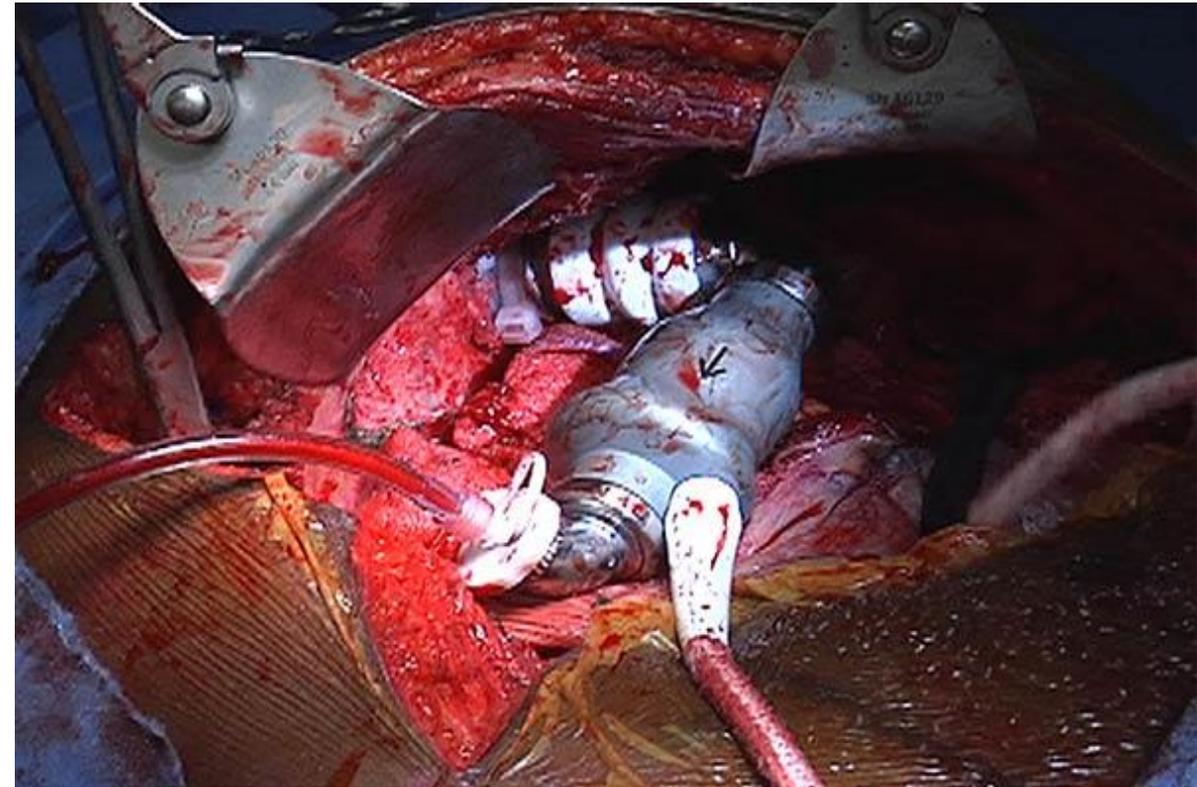
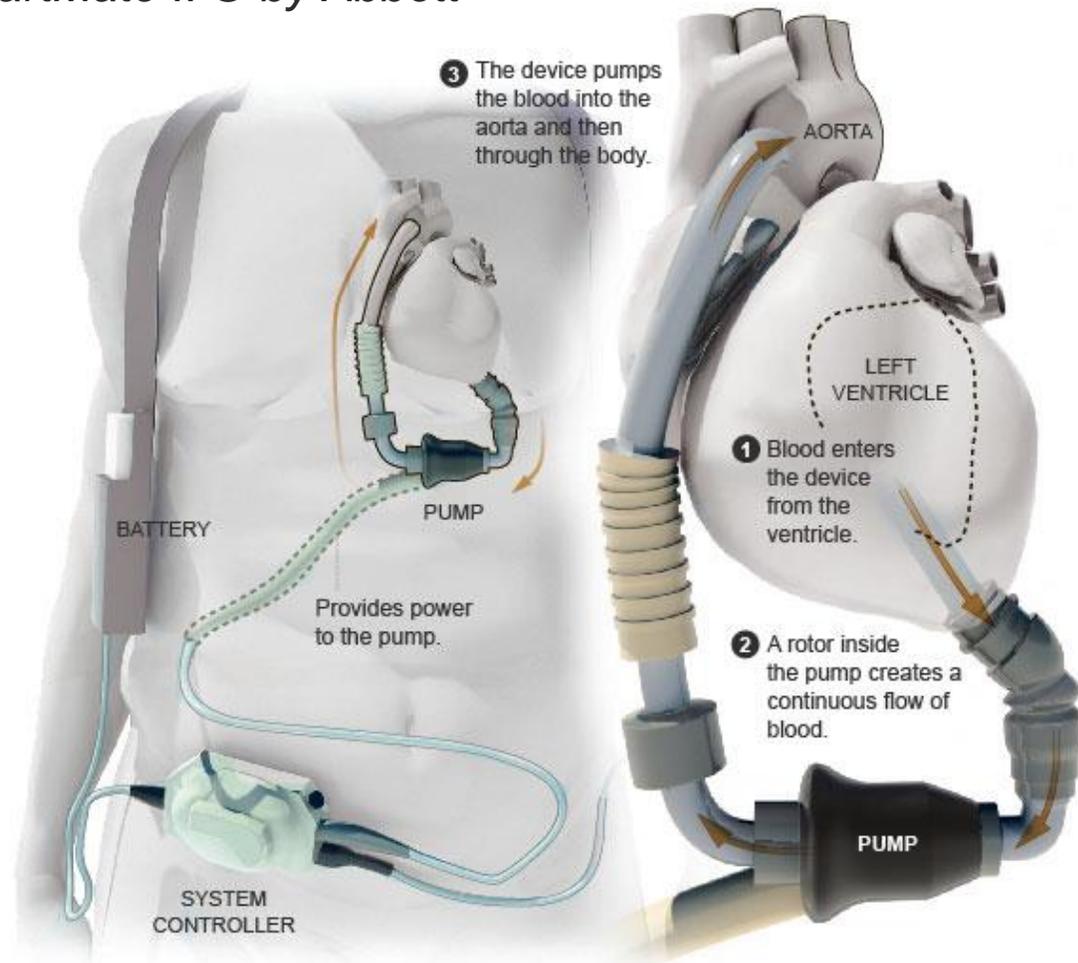
Die before transplantation

CURRENT SYSTEM

Current VAD

HeartMate II® by Abbott

Bulky and prone to complications

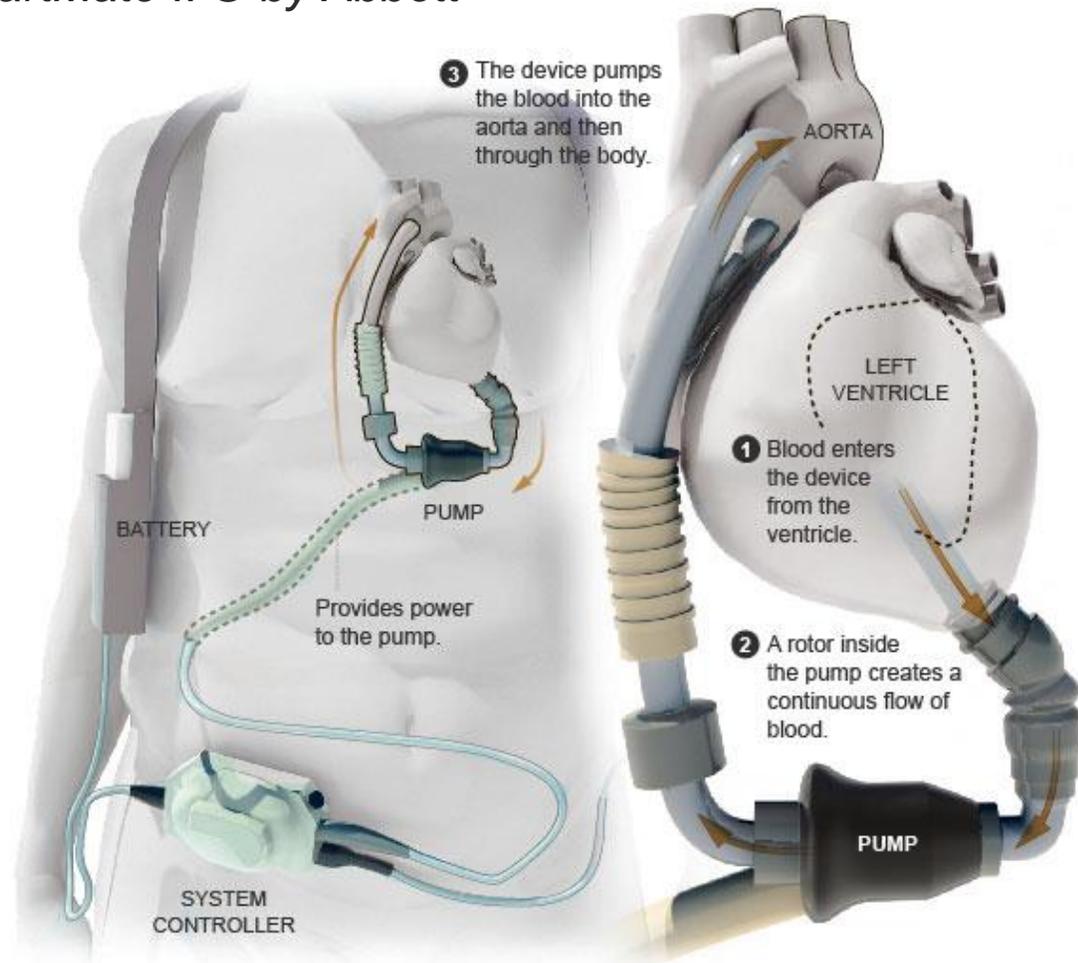


CURRENT SYSTEM

Current VAD

HeartMate II® by Abbott

Bulky and prone to complications



INVASIVE SURGERY

6 in incision



LIFE THREATENING COMPLICATIONS

Poor survivability



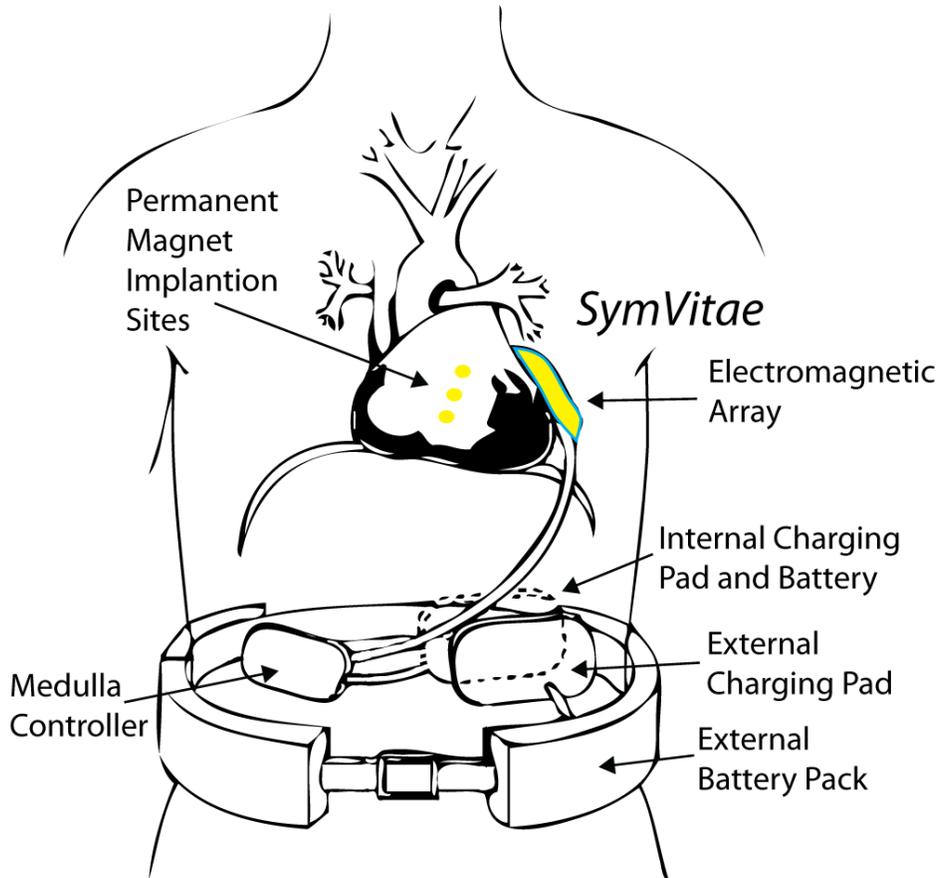
POOR QUALITY OF LIFE

Exit lead & bulky equipment

OUR SOLUTION

New Gen VAD

Disrupting the VAD market



**MINIMALLY
INVASIVE
SURGERY**

1 in incision



**FULLY
IMPLANTABLE**

High quality of life

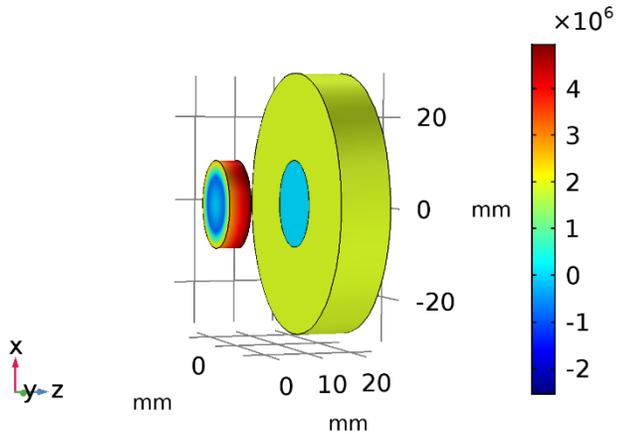


HIGHER SURVIVABILITY

90% survivability to 2 years

Long Road to Approval

Current density (A/m^2)



2019

Develop and test prototypes at a high rate to tune the parameters of the pumping system

2021

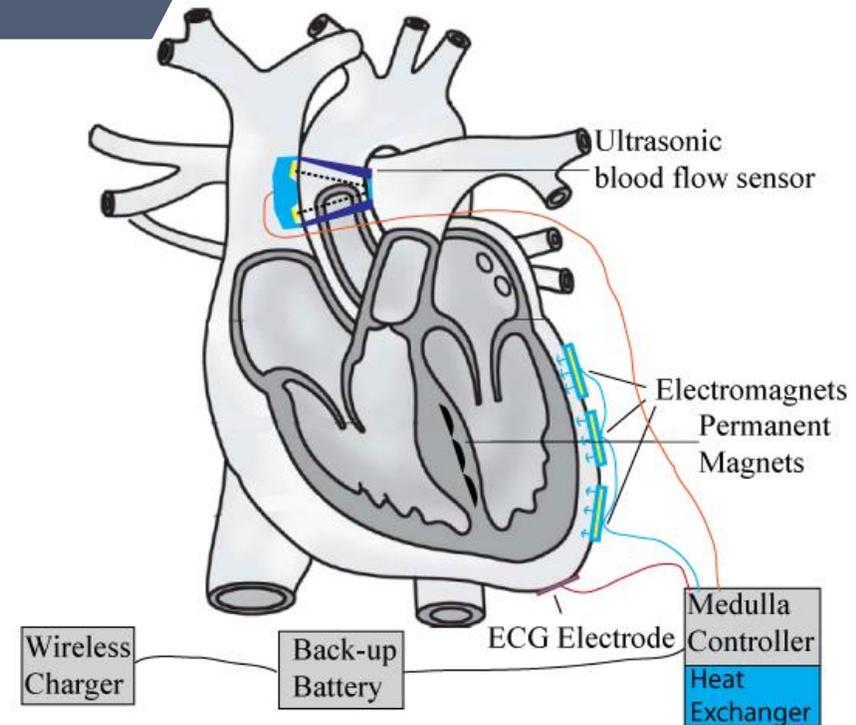
Start with first round of animal trials

2020

Begin to test the system in porcine hearts

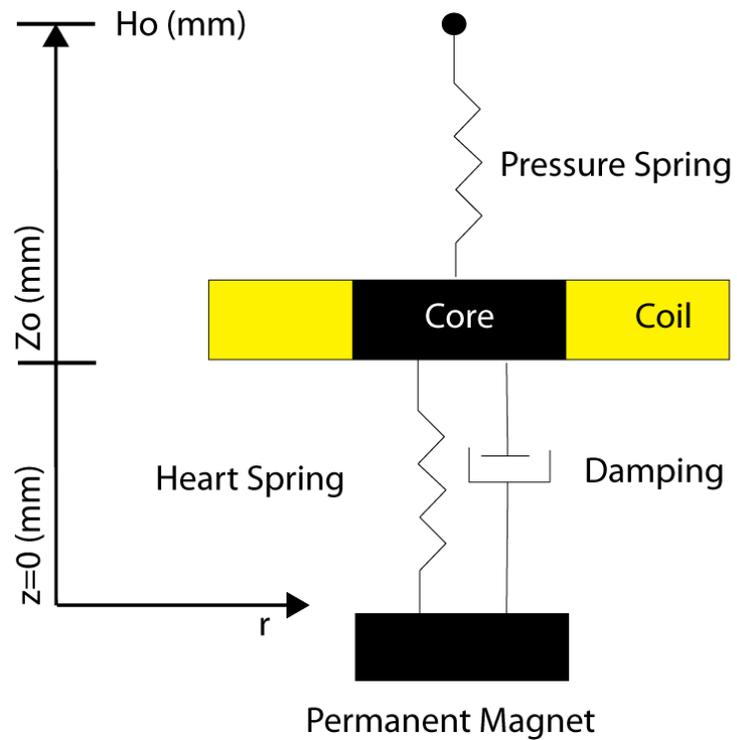
2022

The SymVitae pumping system will be proven through animal trials

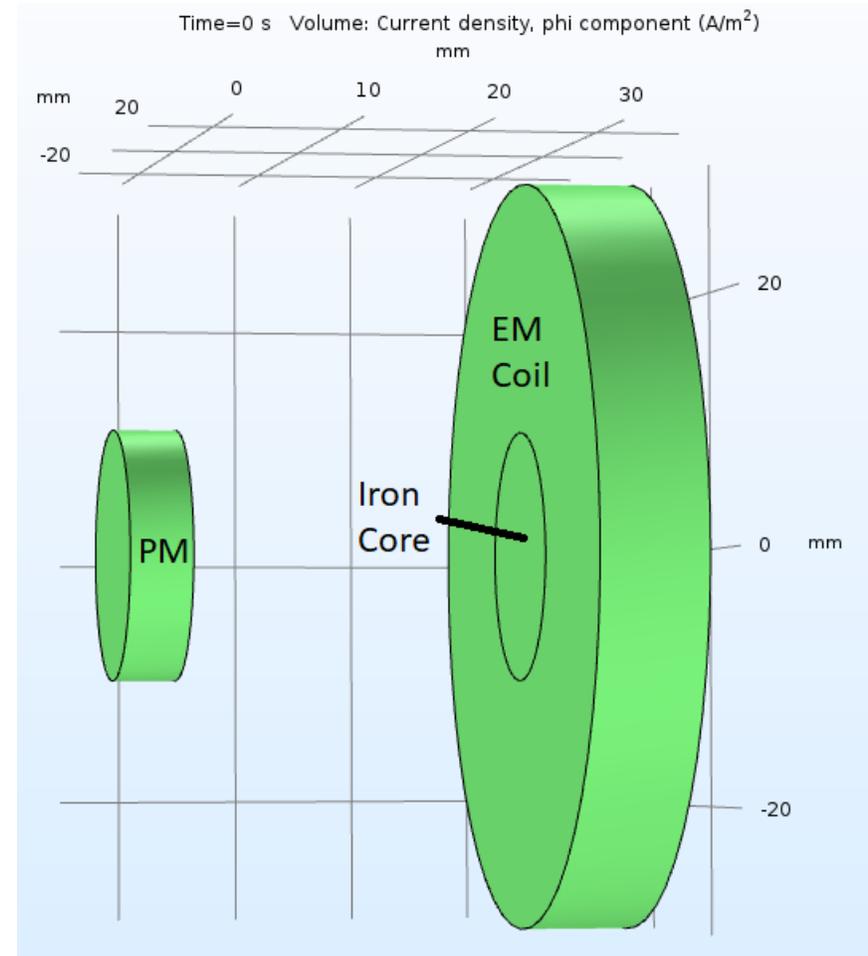


Finite Element Simulator

Accelerating bench trials



$$\frac{dv}{dt} + \frac{\text{heart} * u + Dc * v + \text{pressure} * (u - Ho) - Fz}{M}$$



Finite Element Simulator

Accelerating bench trials

Table 1. EIM Parameters.

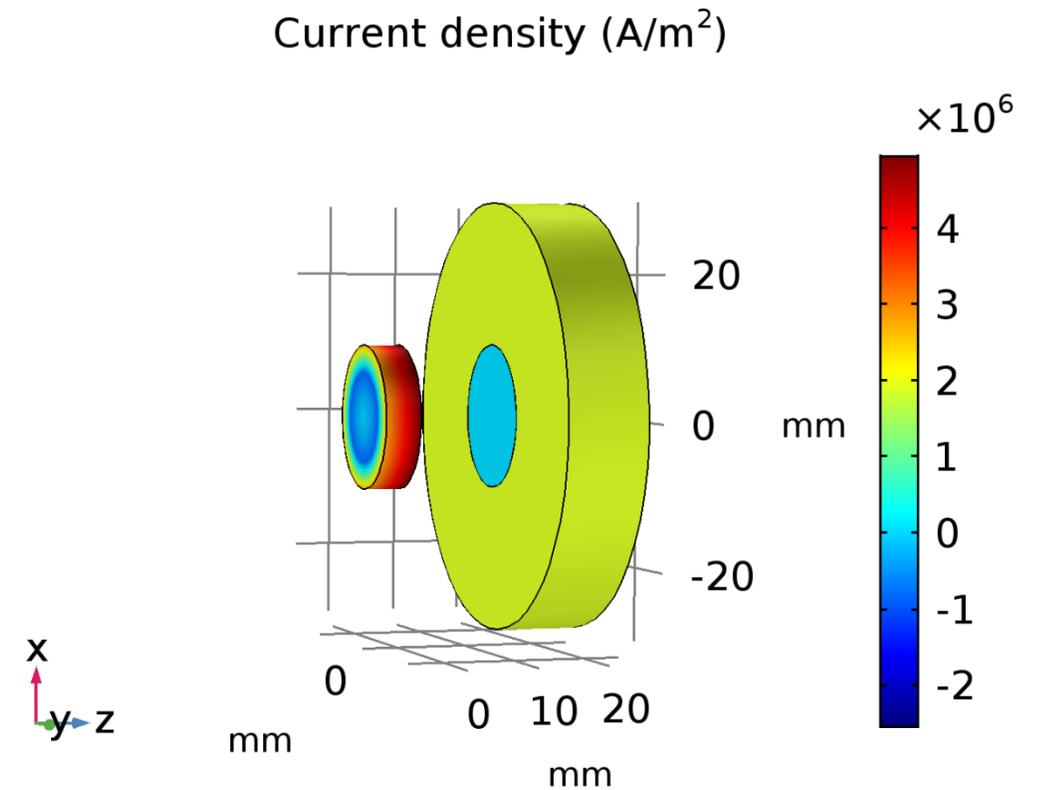
| | |
|---------|----------|
| $N_0 =$ | 300 |
| $\mu =$ | 4000 |
| $I_0 =$ | 3.95 (A) |

Table 2. PM Parameters.

| | |
|-----------------|--------------------|
| $\mu =$ | 1 |
| $\varepsilon =$ | 1 |
| $\sigma =$ | $7e^5 \frac{S}{m}$ |
| $\Phi =$ | 1.32 (T) |

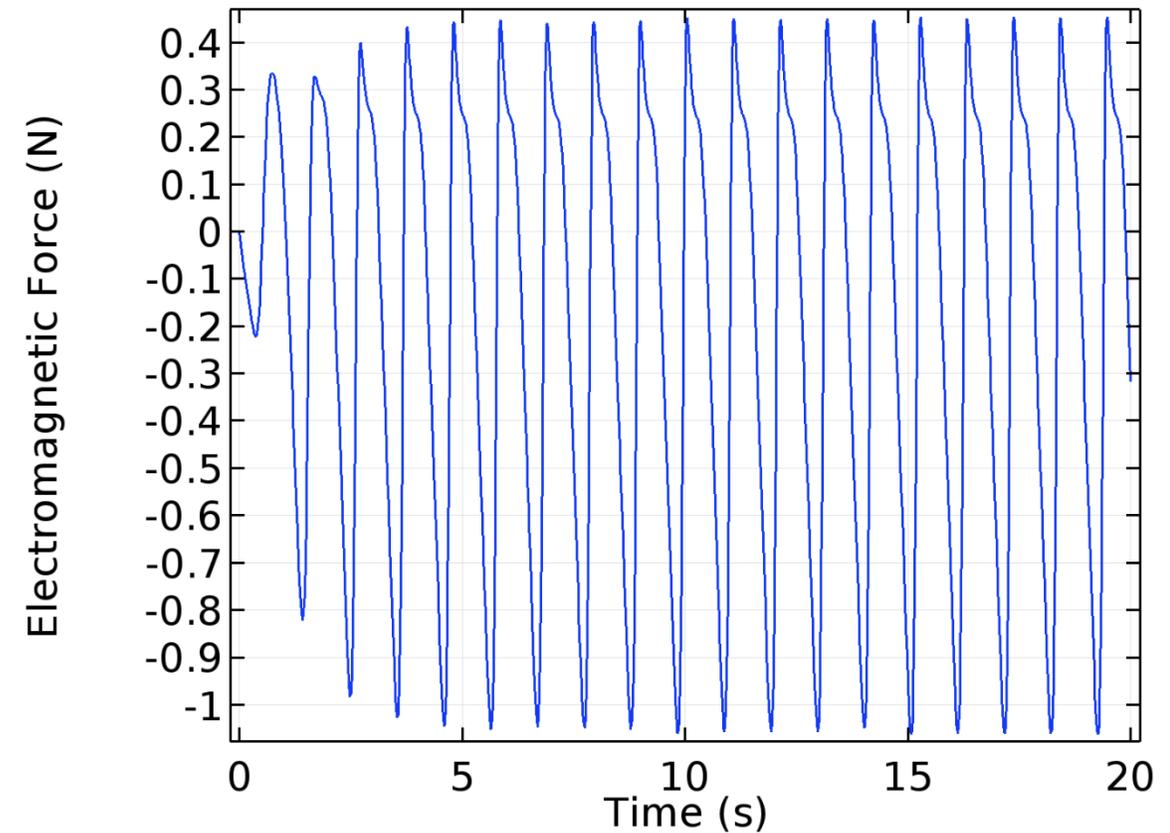
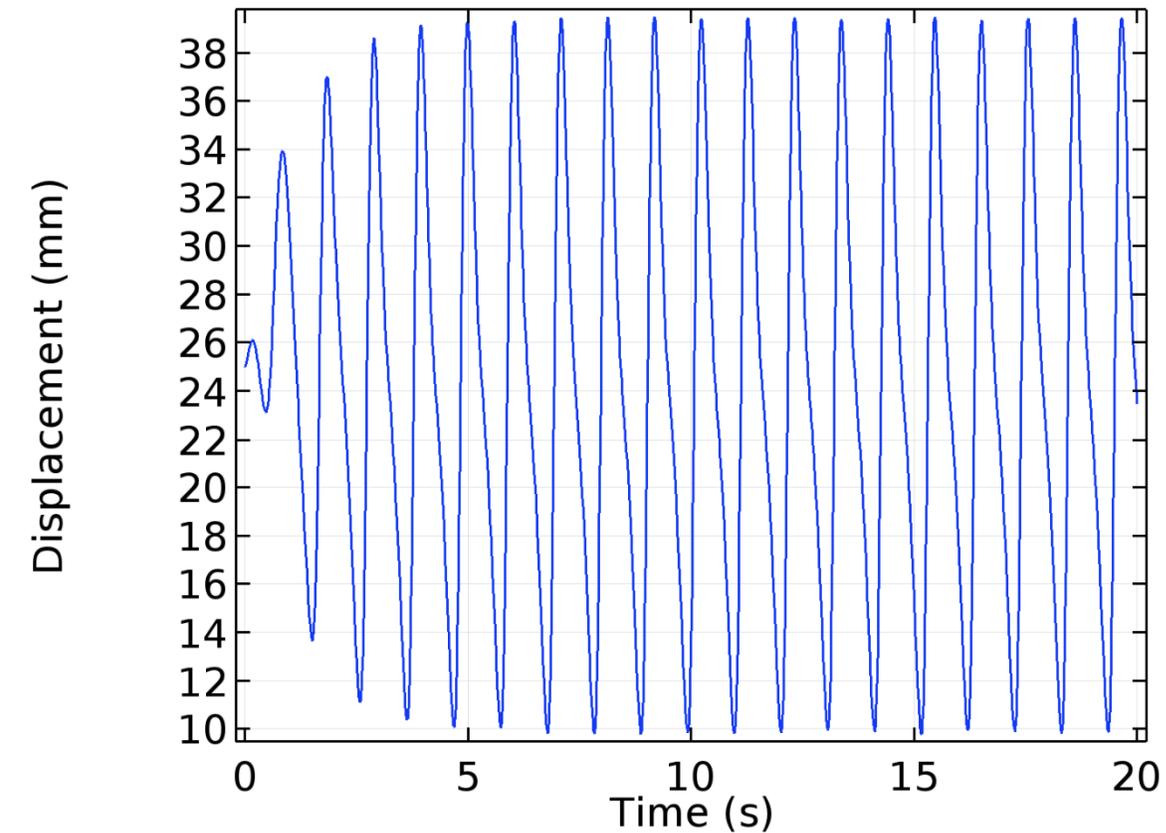
Table 3. LV Parameters.

| | |
|------------|----------|
| heart = | 7 (N/m) |
| pressure = | 60 (N/m) |
| Dc = | 5 |



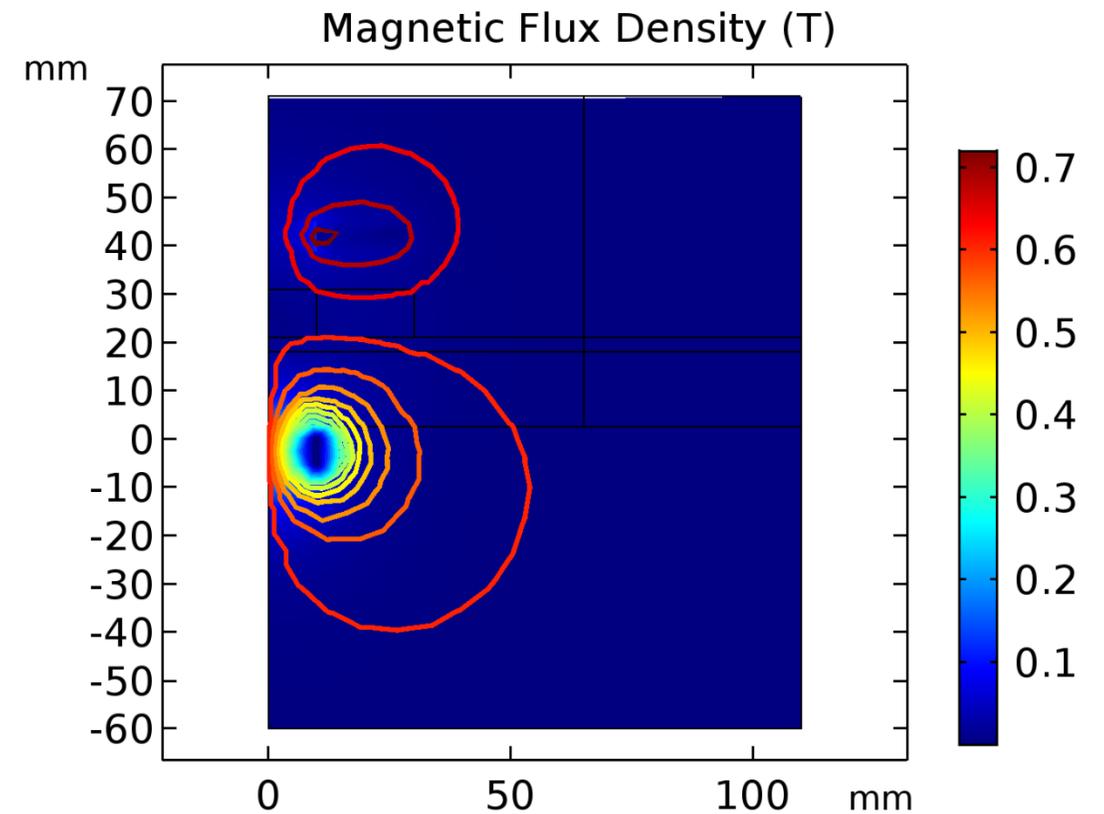
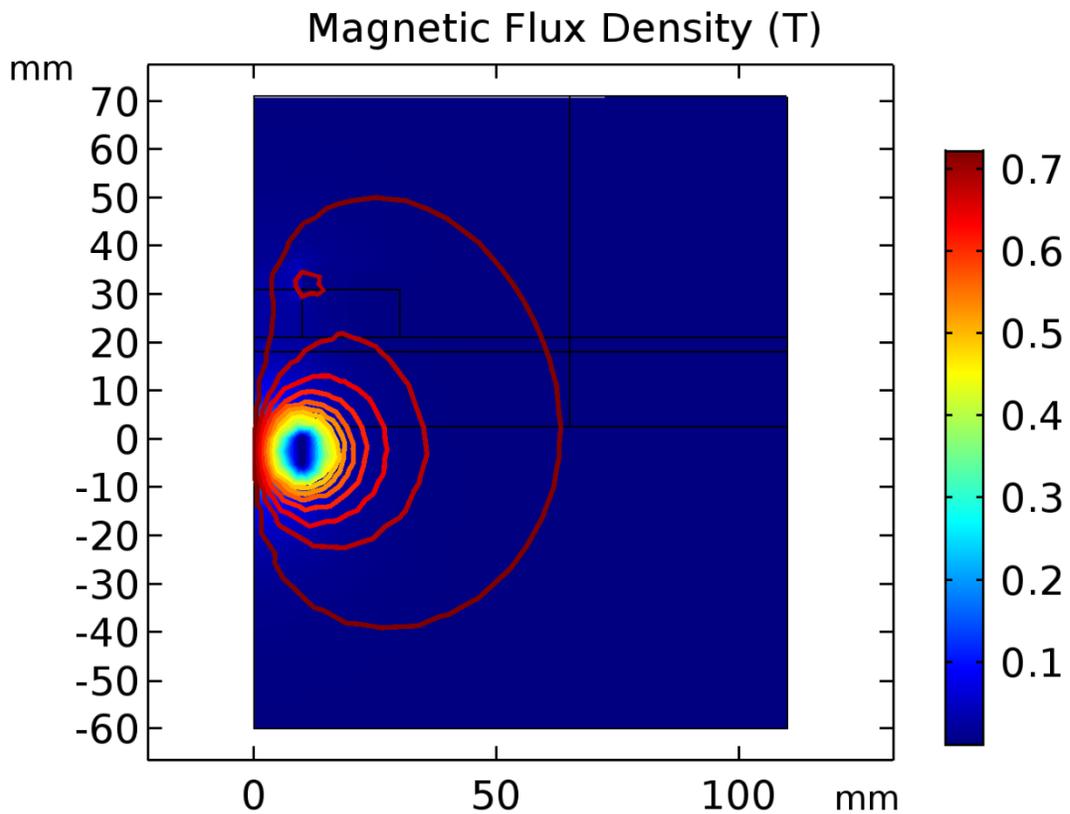
Finite Element Simulator

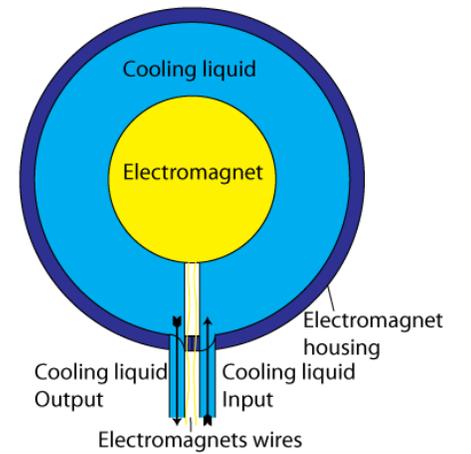
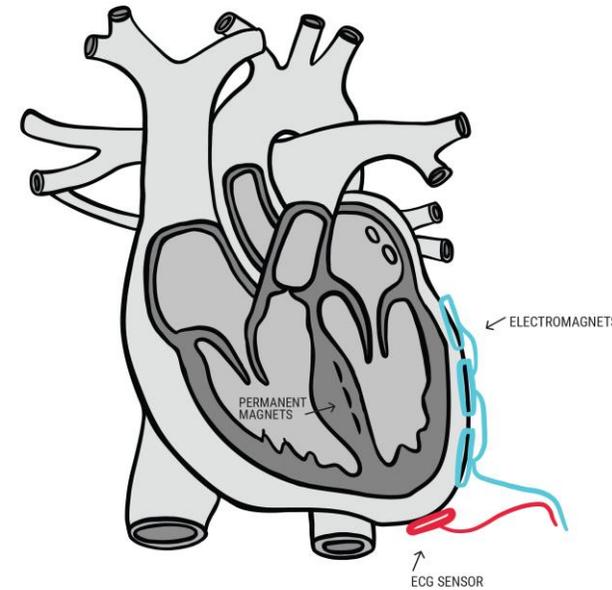
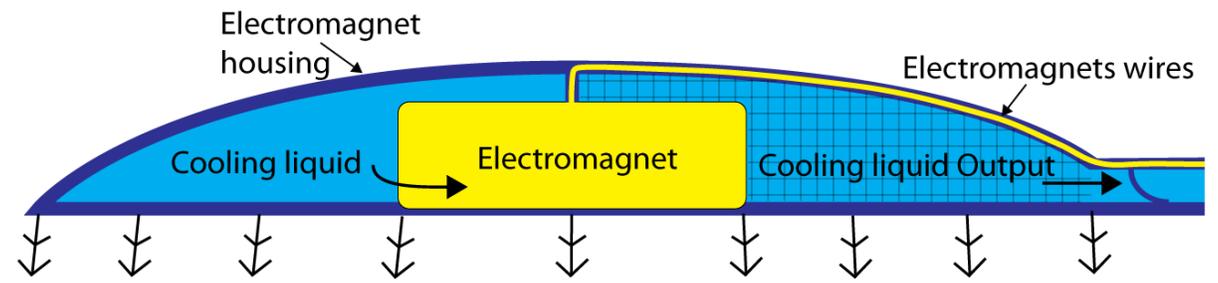
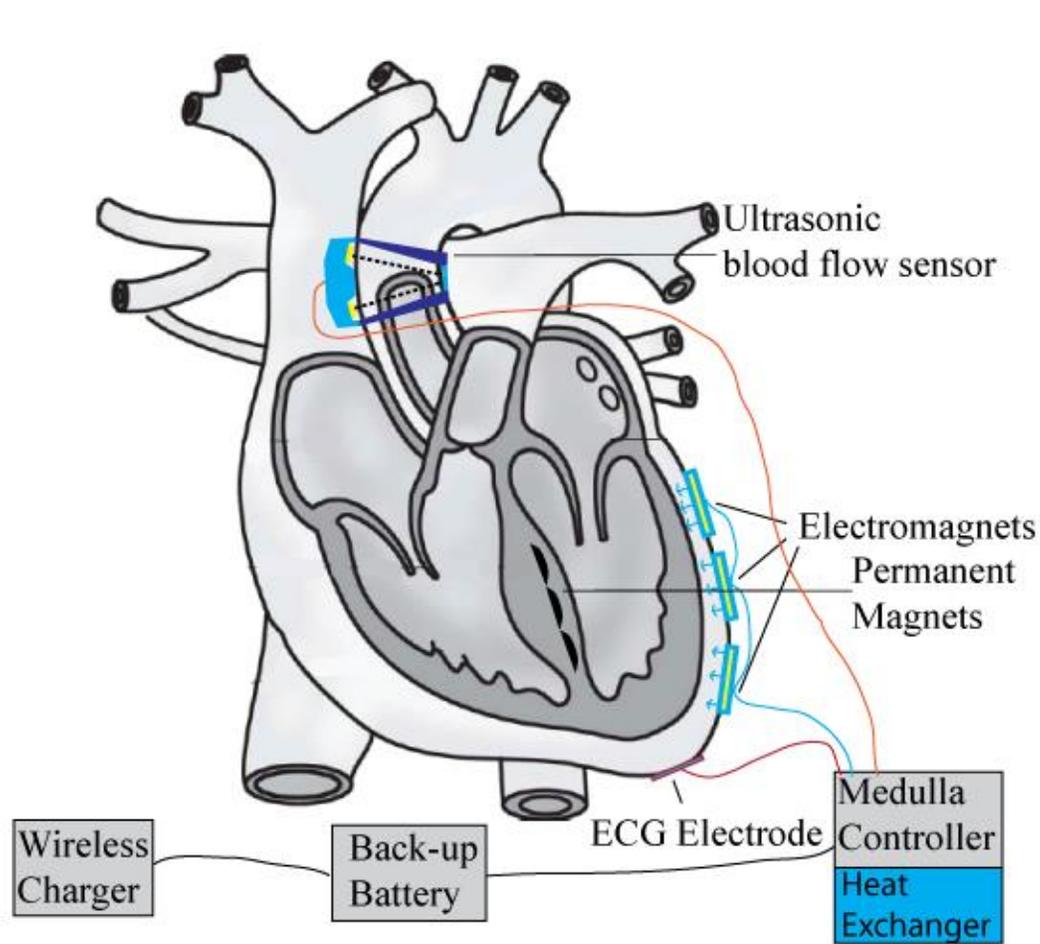
Accelerating bench trials



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Conclusion

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Questions



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