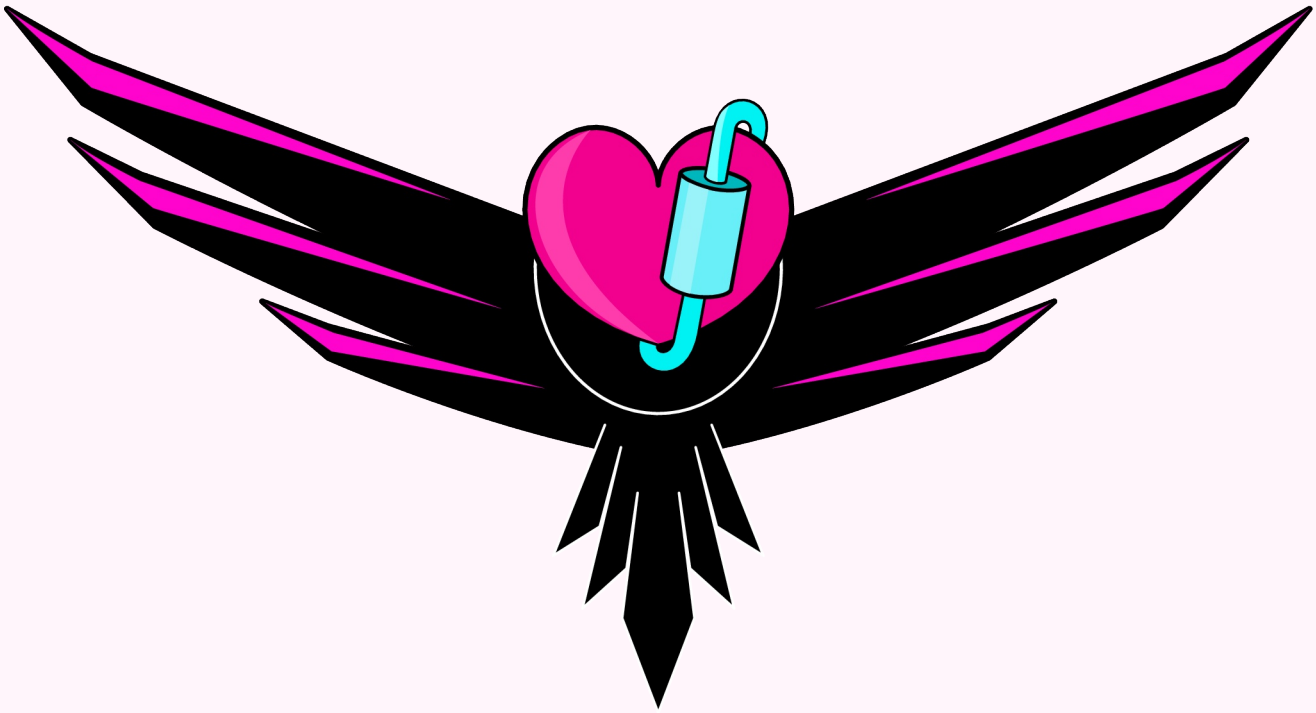
Alpha Version

Libre VAD



Everything You Need To Know To Build A Ventricular Assist Device

A Free/Open Source Book, Available At:
www.mehranbaghi.com/libre_vad/

Contents

Chapter 1

Preface

Welcome to Libre VAD. We are designing a free/libre/open source ventricular assist device (VAD) to help patients with a failing heart. According to the World Health Organization, ischaemic heart disease is the leading cause of death in the world, claiming more than 9 million lives in 2016.[1]

A VAD reduces the load on the heart by pumping blood and improving circulation.

It can be used as a bridge to transplantation which means it keeps patients alive and improves their condition while waiting on the long list of heart transplants.

In some cases it helps the heart to recover and eliminates the need for the transplantation. It can also be a destination therapy which means it will improve and increase the lifespan of patients that are not eligible for a transplant.

1.1 Disclaimer

Libre VAD is a collaborative and evolving project. It contains errors, inaccuracies and imperfections. There is absolutely no assurance that any statement contained or cited in an article touching on medical matters is true, correct, precise, or up-to-date. The overwhelming majority of such articles are written, in part or in whole, by nonprofessionals. Even if a statement made about a medical matter is accurate, it may not apply to you or your symptoms.

The medical information provided on Libre VAD is, at best, of a general nature and cannot substitute for the advice of a medical professional (for instance, a qualified doctor/physician, nurse, pharmacist/chemist, and so on).

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Nothing on the Libre VAD website or related websites should be construed as an attempt to offer or render a medical opinion or otherwise engage in the practice of medicine. For more information please take a look at the License section.

[1] World Health Organization, "The Top 10 Causes of Death" (https://www.who.int/en/news-room/fact-sheets/detail/the-top-10-causes-of-death, May 2018).

1.2 How to Contribute

This is a libre/open source project. It is hosted on GitLab and any contribution is welcomed and highly appreciated.

This book is a work in progress and will change frequently. always check that you have the latest release.

[TODO] Add detailed information on how to commit to a git repository for beginners.

1.2.1 List of Contributors

1.3 Acknowledgment

The pdf, webpages and ebooks are produced with scripts around pandoc and other free software. see the gitlab page.

Some parts of the Disclaimer section are taken from wikipedia's medical disclaimer page.

1.4 License

Chapter 2

Introduction

VAD design is a multidisciplinary field spanning from computer, electrical and mechanical engineering to different medical and biological disciplines:

- Electrical Engineering
  - Brushless motor design
  - Magnetic bearings
- Mechanical Engineering
  - Centrifugal pump design
  - Fluid mechanics
  - Structural analysis
- Biological Challenges
  - Thrombosis
  - Hemolysis
  - Infection
- Computer science
  - Numerical analysis
- Software
  - OpenSCAD (or ImplicitCAD)
  - FreeCAD (Path workbench)
  - OpenFOAM
  - Salome-Meca
  - KiCad
  - SPICE
  - Camotics
  - LinuxCNC + GMOCCAPY GUI
  - git

One of the most important steps of building a complicated device like a VAD is simulation. In the next chapter we are going to study the finite element method (FEM) which is used in magnetic fields or fluid dynamics simulation.

Chapter 3

Finite element method

Finite element method (FEM) is one approach to numerical analysis. The basic idea of numerical analysis is to discretize and approximate hard to solve equations. Equations like Navier-Stokes that describes the motion of viscous fluids or Maxwell's equations of electromagnetism. These discretization algorithms are the foundation of most simulation programs.

Chapter 4

To Be Continued…

As I said in the Preface, this book is a work in progress. So stay tuned and always check for the newest version at https://www.mehranbaghi.com/libre_vad.

Bibliography

World Health Organization. “The Top 10 Causes of Death.” https://www.who.int/en/news-room/fact-sheets/detail/the-top-10-causes-of-death, May 2018.

Is it possible to build a complicated device such as a VAD in an open and collaborative online community?
Lets find out!

This is a work in progress. Go to my website to download the latest version or to contribute to the git repository:
www.mehranbaghi.com/libre_vad/