

R&D and Mechatronics

Blending mechanical design with automation

Case: medical rehabilitation device

Conducting background research

1

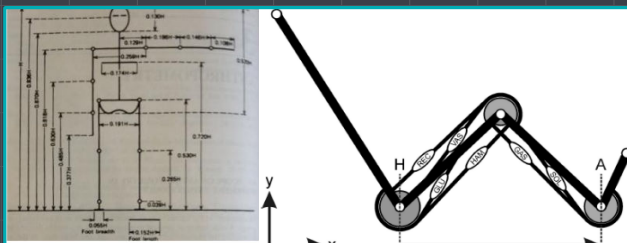


Figure 2.2. Body segment lengths expressed as a fraction of body height [34]

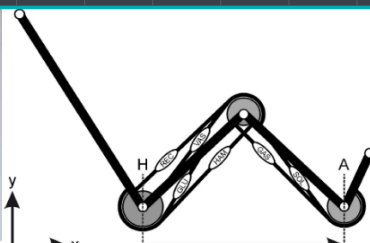


Figure 2.3 Musculoskeletal model [36]

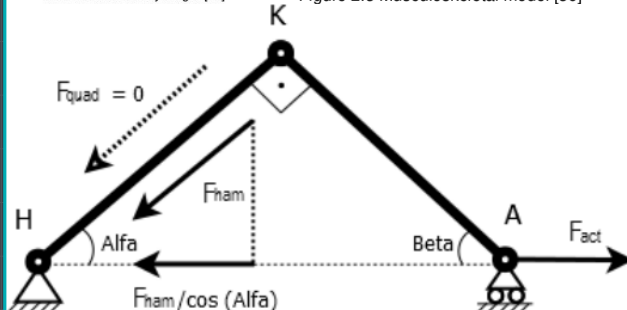


Figure 2.4. Derived physical model

Developing conceptual CAD model

2

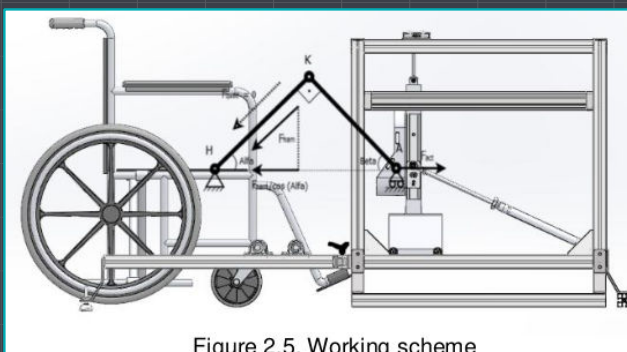


Figure 2.5. Working scheme

Complexity



Time



Cost



Client contacted Knowera with request to research and develop a rehabilitation device concept for people with acquired muscle stiffness of lower limbs, also known as "stiff person syndrome" (or "stiff man syndrome")

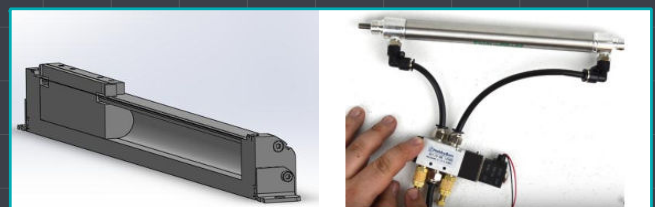


Figure 4.10. The inner structure of rodless pneumatic cylinder



Figure 4.11. Fittings with air speed control [87]



Figure 4.12. Electrical solenoid (left) [88] and manual lever (right) [89]

3

Researching different kinds of actuators (pneumatic, hydraulic, electric, etc.)

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Researching dynamical properties of the system (limb+device)

4

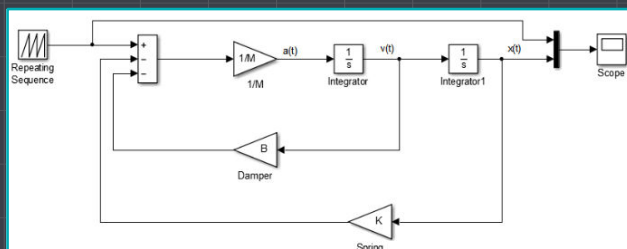


Figure 3.26. Simulation of muscle contraction

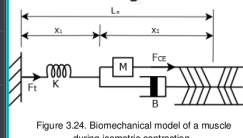


Figure 3.24. Biomechanical model of a muscle during isometric contraction

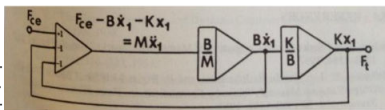


Figure 3.25. Reference model [34]

Developing control algorithm

5



Figure 5.1 PID controller built on operational amplifiers

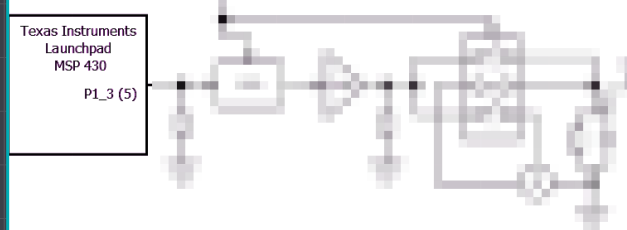


Figure 5.8 Circuit diagram controlling block.

Complexity



Time



Cost



6

Validating results

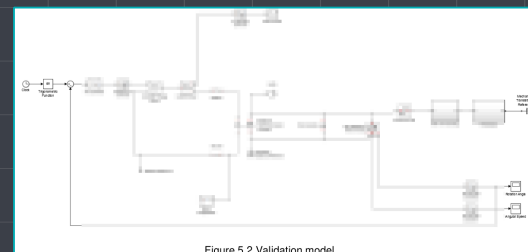
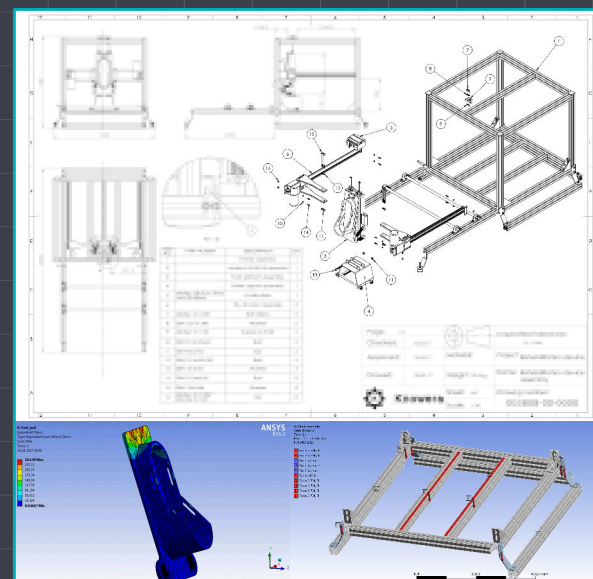


Figure 5.2 Validation model



7

Providing client with research report, tech. drawings, BOM, cost approximation, etc.

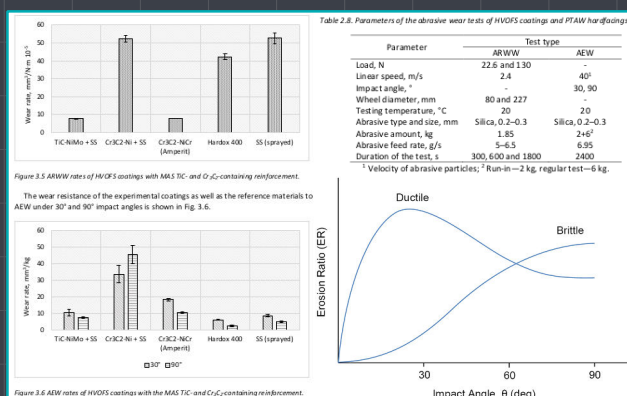
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Case: tribological wear resistance estimator

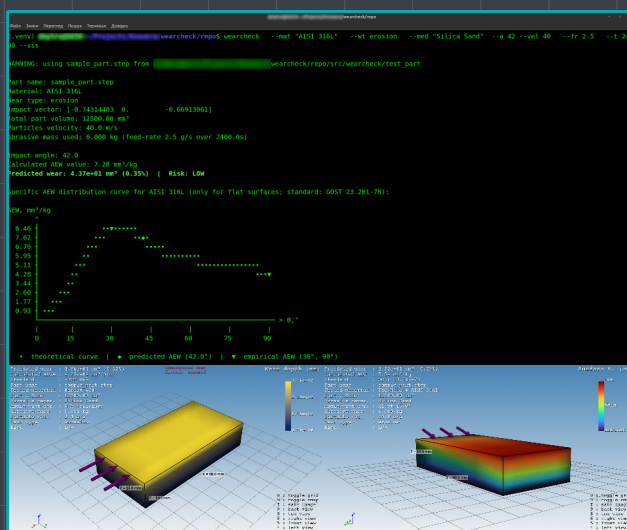
Conducting background research

1



Developing CLI and vis. part : turning science into Python

2



Complexity



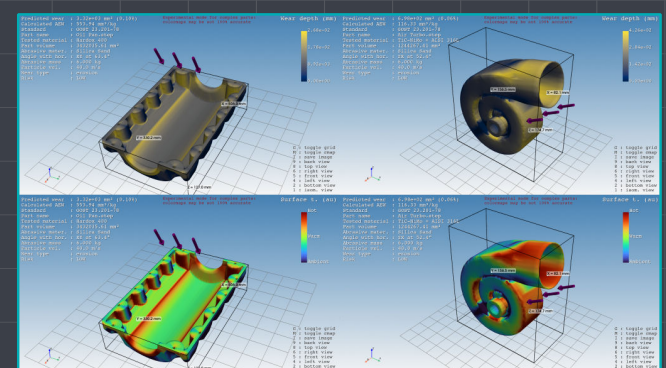
Time



Cost



Client contacted Knowera with request to develop a cross-platform CLI (command line interface) tribological utility for quick abrasive or erosive mechanical wear-risk estimates on CAD parts



3

Adding ability to calculate complex shapes; providing client with software package