SOFTWARE FOR REAL-TIME CONTROL OF LABORATORY DEVICES

Interreg ATCZ215
ImageHeadstart

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EUROPEAN UNION
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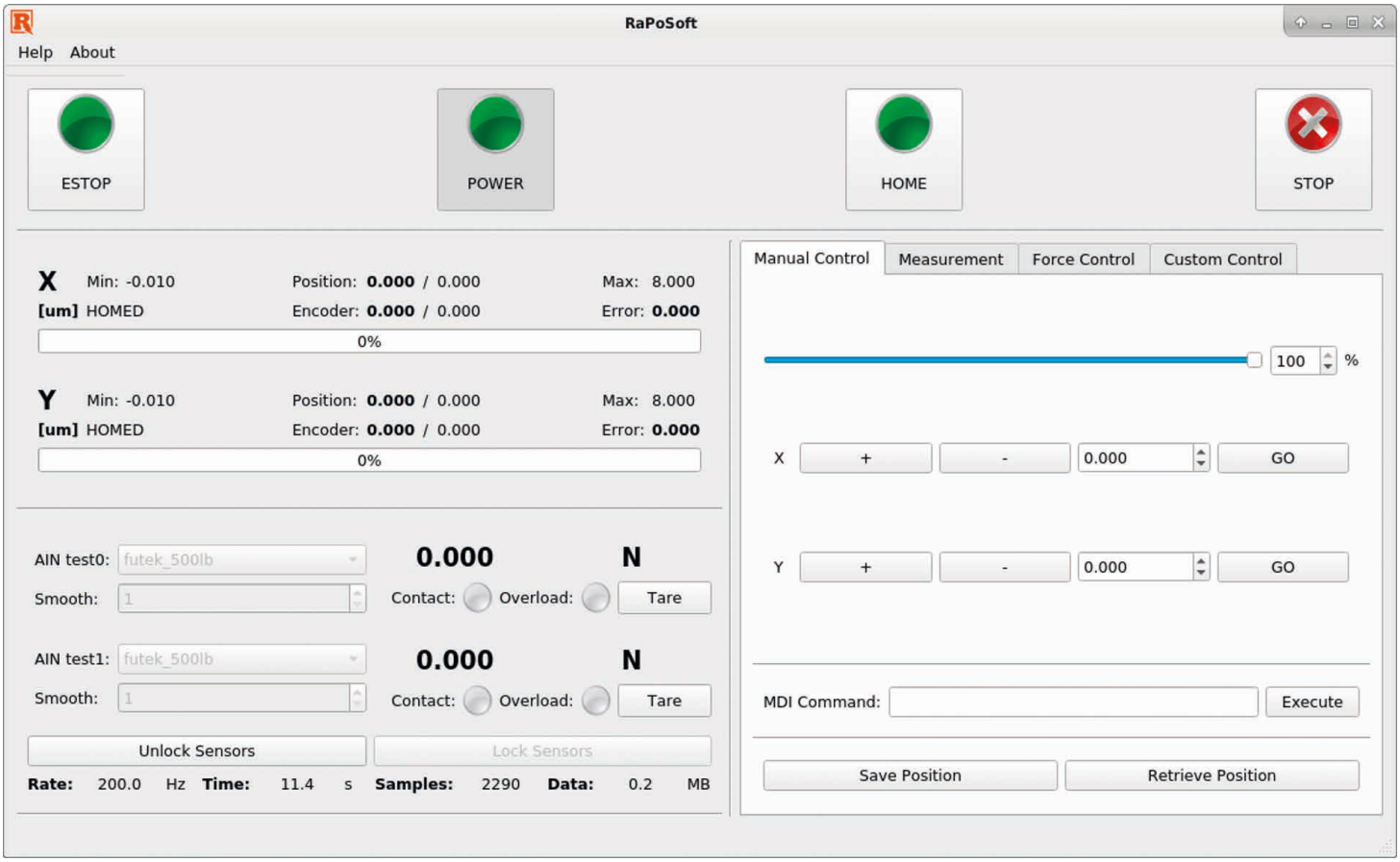
Overview

The RaPo is a modular software tool for real-time control (positioning and data acquisition) of wide range of custom laboratory devices primarily in the field of material and biomedicine research. The software allows single- or multi-axial loading, testing under controlled ambient conditions and simulation of physiological processes. All these experimental procedures may be combined with optical or X-ray imaging.

The software is capable of high-precision measurement with sampling rate up to 500Hz. The positioning precision is up to 50nm. The output data are contained in an ASCII based text file.

The software tool is based on an open-source project LinuxCNC. The control software is written in Python programming language and uses the LinuxCNC Python Interface to communicate with LinuxCNC internals through Python. For Graphical User Interface (GUI) development, a Qt framework in cooperation with PyQt binding for Python was used.



RaPo graphical user interface

LinuxCNC
open source CNC machine controller

Python
high-level and general-purpose programming language

QT
widget toolkit for creating graphical user interfaces

Functionality

Multi-channel data acquisition, various types of sensors
- load cells
- thermometers
- acoustic sensors
- high-resolution CCD cameras, X-ray data

Experimental procedures
- displacement-driven loading
- force-driven loading – linear force, cyclic loading, custom functions
- controlled sample environment (temperature + fluid flow)

Displacement-driven loading
- linear loading
- custom functions from sampled data

Force-driven loading
- feedback using load cells
- linear force: F(t) = a*t + b
- cyclic loading: sine, square, triangle, sawtooth (fatigue testing)
- custom functions from sampled data

Controlled sample environment
- sample temperature controlled by circulating medium[1]
- controlled flow rate of the fluid
- preserving, stimulating and aggressive media[2]
- fluid flow controlled using a pump driven by DC motor

Real-time plot of the obtained data

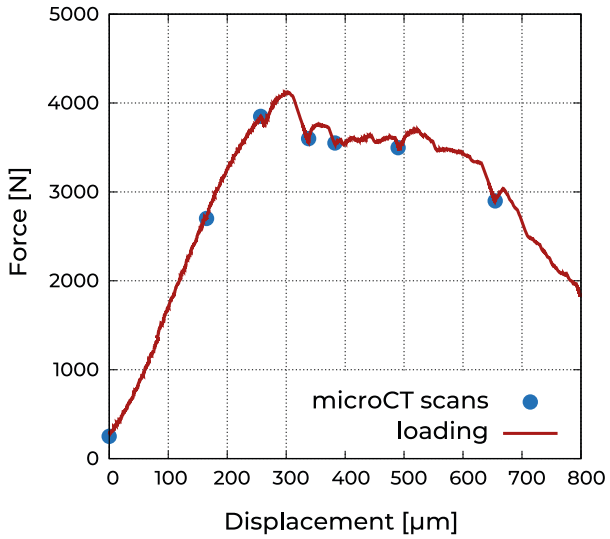
Programmable scripting interface through Python (for creating complex and fully automated experimental methods)

1) heating and cooling platforms for operation in 0-80 °C

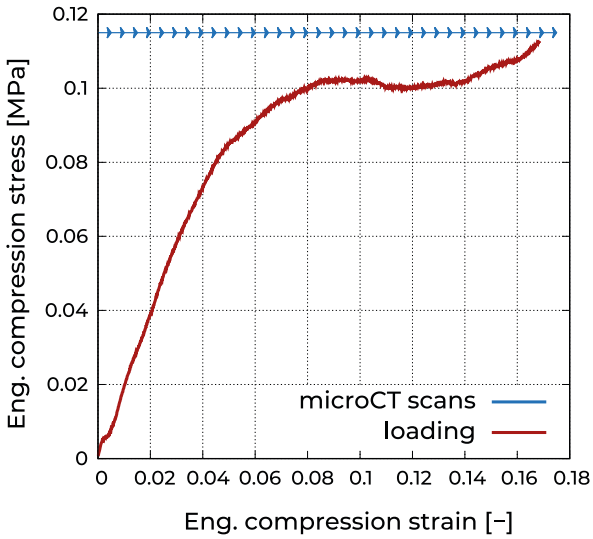
2) simulated body fluid, purified water, corrosive fluids, etc.

Application

The software used for the overall control of the laboratory X-ray micro tomograph with integrated in-situ loading stage for mechanical testing under controlled ambient conditions.



Loading curve of titanium construct prepared by additive manufacturing observed by time-lapse microtomography.



Deformation behaviour of gellan gum based bone scaffold observed by on-the-fly microtomography.

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