Arduino controlled sample positioning stage and automatic data acquisition using OMDAQ3

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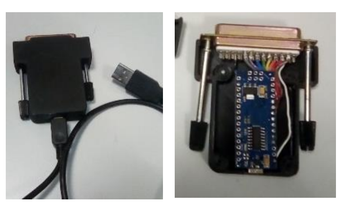
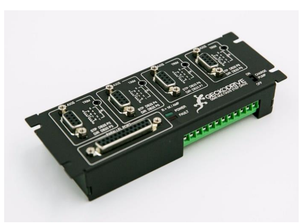
Introduction

In this work a simple, effective and low-cost system is described for actuating a stepper-motor driven x-y stage based on an Arduino Nano board together with a multi axis digital stepper driver module (Geckodrive G540) with commanded positioning and automatic data acquisition under OMDAQ3 environment. .

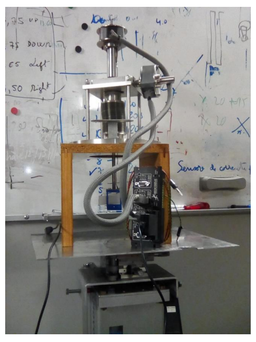
Hardware



Arduino Nano board
USB connection port:
- any type of computer; no need for internal bus cards
DB25 connector:
- Connection to the stepper-motor power driver
3D printed box:
- accommodates both the Arduino board and the DB25 male connector (robustness and ease of connection)



Stepper-motor driver
Geckodrive G540
- Controls up to 4 stepper motors
- DB9 output connector to stepper motors
- DB25 input/output connector
- Power from external PSU (18– 50 V; 3.5 A máx.)
- Short circuit, overvoltage and overcurrent protection

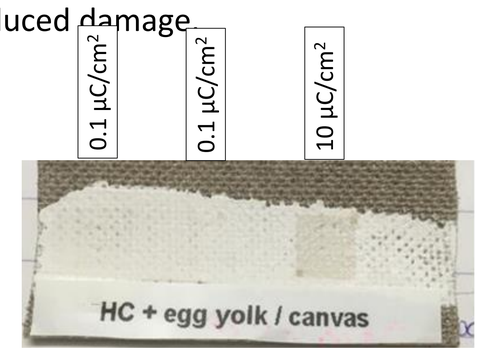


Motorized x,y stage
- 50 mm dislocation amplitude both in x and y
- 4 phase stepper motors RS 318-711 (wired as 2 phase, rating: 12 V, 0.24 A/phase w/ 240 Ω limiting resistor across pins 1 and 5 of DB9 connector)

Application

see more

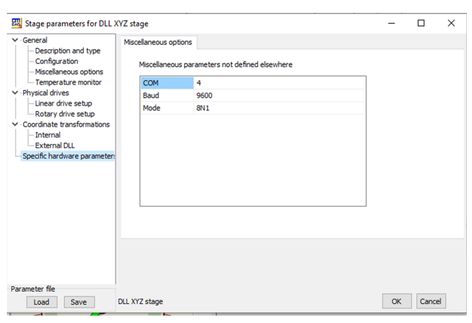
The hardware/software combined system previously shown was used in our external beam setup (1×1 mm^2 exit nozzle window dimensions) for the irradiation of easel painting coupons containing lead white pigments with different binders and supports. The experiment and further analysis required sample irradiated areas of 8×8 mm^2 with accurate measurement of accumulated beam charge per unit area in order to determine exposure thresholds for preventing beam induced damage.

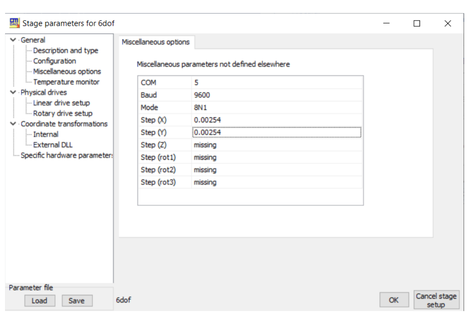


- Ion beam irradiation alteration test on a lead white pigment (lead carbonate form) with an egg yolk binder and painted on canvas.
- 2 MeV proton beam – tested fluences: 0.1 µC/cm^2, 1 µC/cm^2 and 10 µC/cm^2,
- Irradiated area 8x8 mm^2.

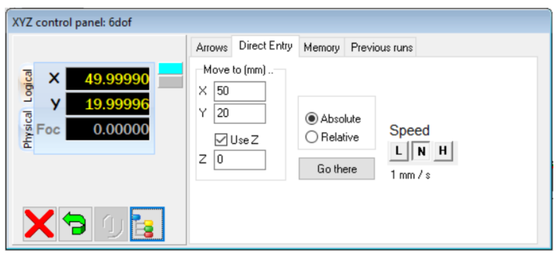
Software

OMDAQ3 interface
- DAQ3 built-in capabilities allow modifying DLL source code for adapting to users motor control interface (allows controlling a system with up to 6 degrees of freedom – 3 translations and 3 rotations).
- Offers USB communication support from PC to Arduino I/O port.
- DAQ3 “hardware options” window allows providing communication parameters (I/O port, baud rate and handshake) together with the definition of motion parameters (e.g. minimum displacement).





- Programmed runs using an EXCEL CSV script file for defining stage to move, scan type (e.g. full scan, point) and data acquisition presets (e.g. time, spectrum count).
- C++ code compiled using Embarcadero’s C++ Builder 10.3.3 Community Edition for obtaining a DLL file (must be named OmXyzDll.dll to be recognized by OMDAQ-3).



Arduino Board Initialization and operation
- Use of modified Arduino open-source libraries
- Waits receiving a string with motion parameters:
“Xd Xs Yd Ys”
That considers 2 linear stages each of them with movement direction (*d)* and number of steps (*s)*.
- Sends to G540, motor direction bit and (s) pulses (digital outputs).
- Gets ‘flag’ from G540 signalling end-of-segment (motion)

Summary

- A low cost, off-the-shelf solution for motorized x,y stage control is devised and provided.
- Rewritten DLL and integration with OMDAQ3 environment using “universal” USB communications with Arduino Nano board.
- System tested for accurate exposure of painting test coupons.

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