Increasing Precision on an Automated System for Optogenetic Experimentation

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Figure 1 Drosophila Source: epfl.ch/labs/ramdya-lab/



Video 1 Optobot Source: epfl.ch/labs/ramdya-lab/



Recap:



e system

Video 2 Failure mode 1: Carousel motor failure



Video 3 Failure mode 2: Gripper failure (pick)

Video 4 Failure mode 2: Gripper failure (place)



System overview



Figure 2 Overview of improved system



Carousel module

1. Problem to solve:



2. Reasons for the problem: Stepper motor, step loss under heavy loads, open-loop control

3. Methods to solve the problem: use a stronger motor, close the control loop.

Serial	Holding torque	Rated current	Weight	Length	Shaft diameter
17h2a8413(old)	0.52Nm	1.3A	362g	$72 \mathrm{mm}$	5mm
42STH38(new)	1.8Nm	1.7A	457g	$102 \mathrm{mm}$	8mm



Table 1 Comparison of the carousel motor

$\left[\right]$	Serial	Max speed	Resolution	Weight	Inner diameter
	HKT22	6000RPM	300CPR	4g	4mm





Table 2 Specs of the encoder



Figure 3 Mechanical change of carousel module in Optobot 2.0





Figure 4 Connection logic of stepper and encoder



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Figure 5 Control logic of stepper and encoder

Carousel module test





Gripper and arena module

1. Problem to solve:



- 2. Reasons for the problem: Misalignment of gripper: arena holders bend over time, 1-side connection
- 3. Methods to solve the problem: Redesign the gripper and arena to enable more stable arena holder connection.





Figure 6 Redesign of gripper and arena modules





Figure 7 Gripper module overview





Figure 9 Old and new arena design

Figure 8 Scotch-yoke mechanism





Figure 10 Controlling logic of gripper finger and stimuli lights





Figure 11 Communication graph in gripper control



Gripper & arena module test





Rack module



Figure 12 Capacity expansion



Figure 13 Structure improvement



Overall tests

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Conclusion

- Module tests showing the robustness and functionality.
- Overall test showing the whole working process of the system and coordination between each modules.
- Rack and arena modules do not have many interactions with other modules. But they need to be manufactured and mounted on the carousel so that the movement of gripper can be adjusted.



Evolution of product











