

Self-repairing 3D printer: Ideas

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February 13, 2021

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1 Idea 1: Correcting using Encoder

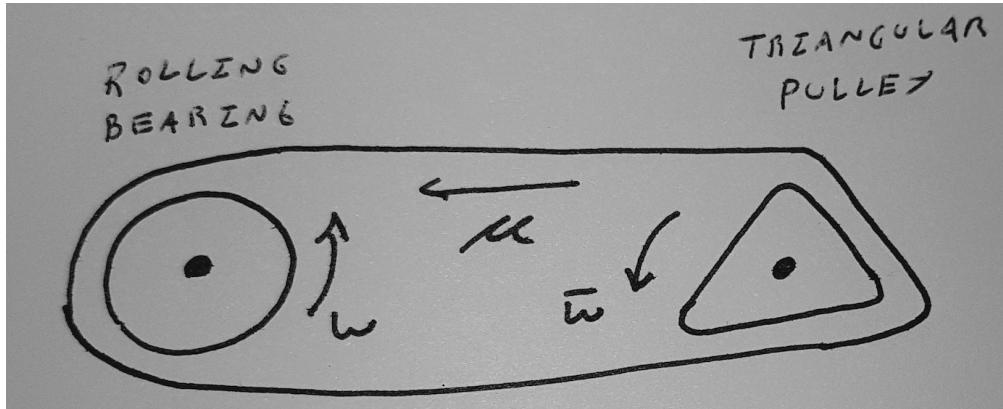


Figure 1: Representation of the x-axes dynamics system. We can observe the timing pulley, rolling bearing, and timing belt.

In the ideal case, using a normal timing pulley, we can say that $\exists K \in \mathbb{R}^+$ s.t. $\Delta w = \Delta \bar{w} = K \Delta u$, representing the lineal relation between the rotation and the belt translation. However, using a non-ideal timing pulley, we have that for very small $\Delta \bar{w}$, there should exist a function $K(\bar{w}, \text{sign}(\dot{\bar{w}}), |\dot{\bar{w}}|) : [0, 2\pi] \times \{0, 1\} \times \mathbb{R} \rightarrow \mathbb{R}$ s.t.

$$\Delta \bar{w} K(\bar{w}, \text{sign}(\dot{\bar{w}}), |\dot{\bar{w}}|) = \Delta u.$$

1.1 Encoder

Using two encoders we can measure $w(t)$ and $\bar{w}(t)$ during the printing process. We designed a prototype to add encoders to the printer.

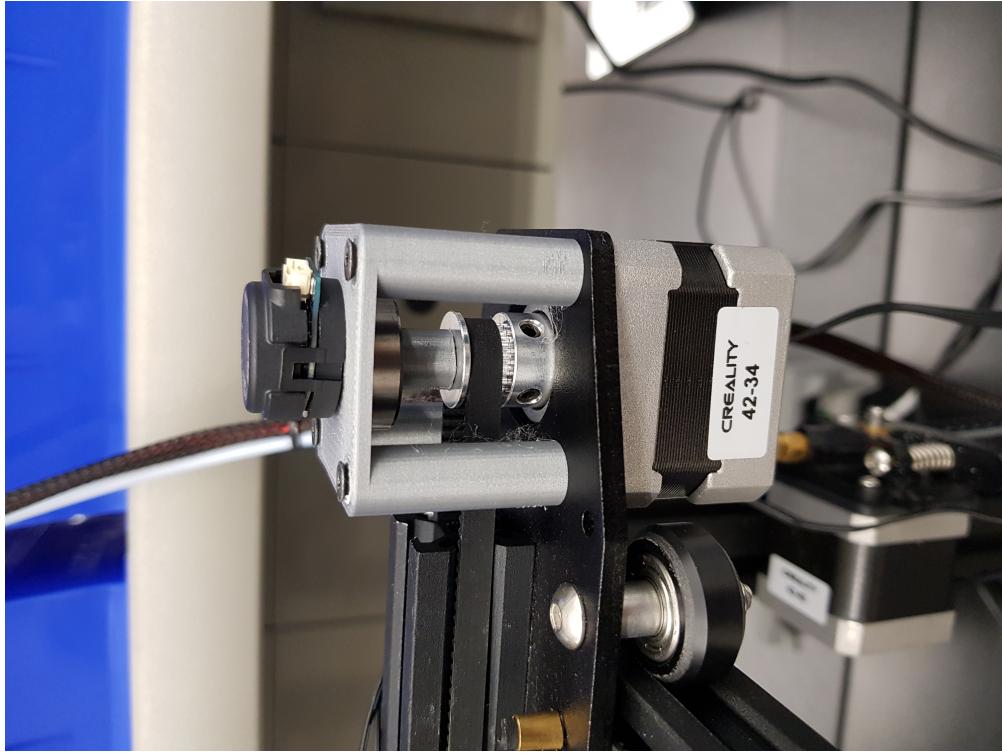


Figure 2: Prototype to test an encoder in the printer's motor.

List of possible steps:

- Once we have the data $w(t)$ and $\bar{w}(t)$, we can simulate a 3D printed model (virtual printer) and measure the error $||\text{REAL 3D MODEL} - \text{3D PRINTED MODEL}||$.
- As we can control the printer from Python, we may be able to find $K(\bar{w}, \text{sign}(\dot{\bar{w}}), |\dot{\bar{w}}|)$ for a fixed $|\dot{\bar{w}}|$. To do this, we map all the function $K(\cdot)$'s domain with Python, and we reconstruct $K(\cdot)$ using the encoders' measurements.
- Using the encoders we can create a control system to reduce the error. See Figure 3.

1.2 What are we doing right now?

Still finding the best way to connect encoders to the printer.

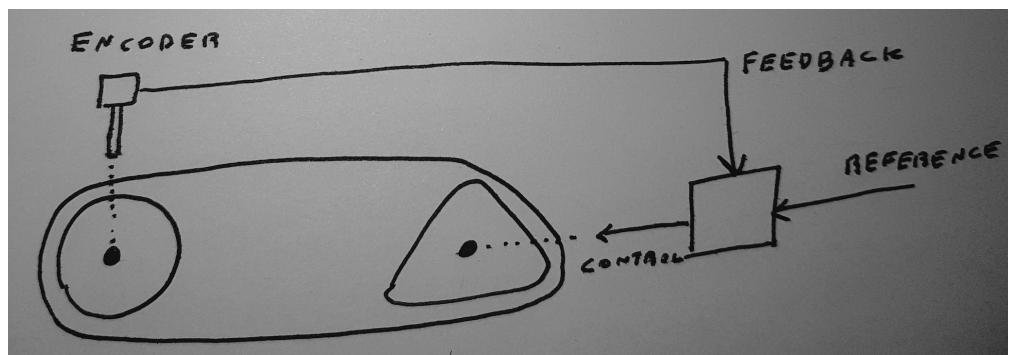


Figure 3: Possible control system using encoders. The reference can be the g-code.