Designing Track for Electrospinning Unit and Cost-Effective Laser Scanning System

Leopoldo Ruffolo, SULI 2024-Fermilab-Marquette University; Sujit Bidhar, Fermilab

Electrospinning Unit Track

**Background:**
- There was an already existing electrospinning unit (Fig. 1).
- The problem is that the nozzles are stationary, causing nanofiber mat to build up in certain spots on the collector, as seen in Figure 1.

**Objective:**
- Design track for electrospinning unit and prevent mat build up.

**Methodology:**
- First constraint in design is that it needs to be made mostly from plastic, due to high voltage.
- Second constraint is that the design needs to be compact given the lack of space seen in Figure 1.
- Third constraint is that the track needed to have a variable stroke length of at least 2 inches.

**Results:**
- The track will be composed of plastic, save the metal screws, track beams, and motor.
- The track will incorporate a 12V DC motor, leftmost item in Figure 3.
- The final design has a stroke from 0 to 3 inches.

Laser Scanning System

**Background:**
- Sample surface is altered by interacting with proton beam e.g., swelling on order of microns (Fig 4).
- Existing devices are typically very expensive and produce large data files that are hard to handle.

**Objective:**
- Design a simple surface scanner using a laser module and a linear stage motor.

**Methodology:**
- Needed to redesign existing laser mount to add stability and adjustablility. Designed and made mount seen in Figure 5.
- Velocity of stage motor is not constant. Sampled 7 speeds 5 times and used these equations, σ\%\text{Err} = \sigma/v_{\text{avg}} and %\text{Err} = \left|\frac{v_{\text{expected}} - v_{\text{actual}}}{v_{\text{expected}}}\right|, to make results in Figures 7 and 8.
- Needed to determine the optimum sampling rate of laser. Used $t_s = \lambda_s/\left(\text{x} + v_{\text{scan}}\right)$, explained in Figure 9.
- Needed to optimize the frequency pass filter on the laser. Used $0.5 + \frac{x_v + v_{\text{scan}}}{\lambda_s} \leq f_{\text{HP}}$ for high pass filter and $\frac{x_v + v_{\text{scan}}}{\lambda_s} \leq f_{\text{LP}}$ for low pass filter. Their baseline noise values are displayed in Figure 10.

**Results:**
- The motor was ran at $v_{\text{scan}} = 0.1\text{mm/s}$, while the laser had settings of $t_s = 1000\mu\text{s}$ and $f_{\text{LP}} = 100\text{Hz}$.
- Similar peak-to-peak results from both systems $= 100\mu\text{m}$; varying peak-to-trough results, $= 35\mu\text{m}$ and $= 9\mu\text{m}$ respectively.
- Data file from laser scanner was significantly smaller than one from microscope.

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