Non-Contact Sensor for Small Tendon Samples

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Introduction

- **Goal: Develop a system to find the cross-sectional area of tendon samples for use in biomedical engineering research**
  - **The embryonic chicken tendons pose several issues that make traditional measurement methods impractical.**
  - **The profilometer currently used in the lab produces unreliable data**
  - **The new system should incorporate the custom grips used in tensile testing to save time .**

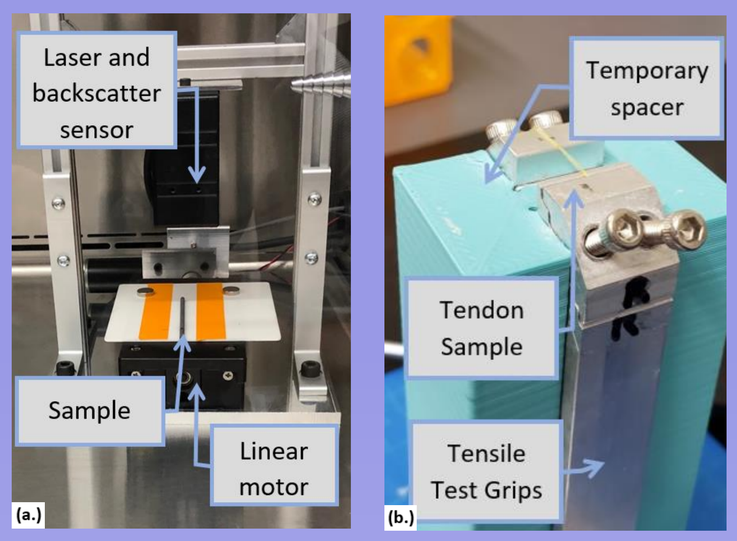

Figure 1. (a.) Backscatter profilometer system currently used in the lab and (b.) the custom grips used in tensile testing experiments.

Concept

- **The Keyence Laser Micrometer system best satisfied the identified customer needs.**

Table 1. Primary customer needs used in determining final design.

Customer Need	Level of importance 1-5
System accurately and reliably measures tendon diameter on the order of 0.5 mm	5
Tendon remains hydrated during measurement	5
System incorporates current lab grips	4
System operates quickly	3

Design Features

- **The system is divided into two subsystems**
  (1) The laser micrometer measures the diameters of the sample.
  (2) The data processing program calculates the average cross-sectional area of the tendon.

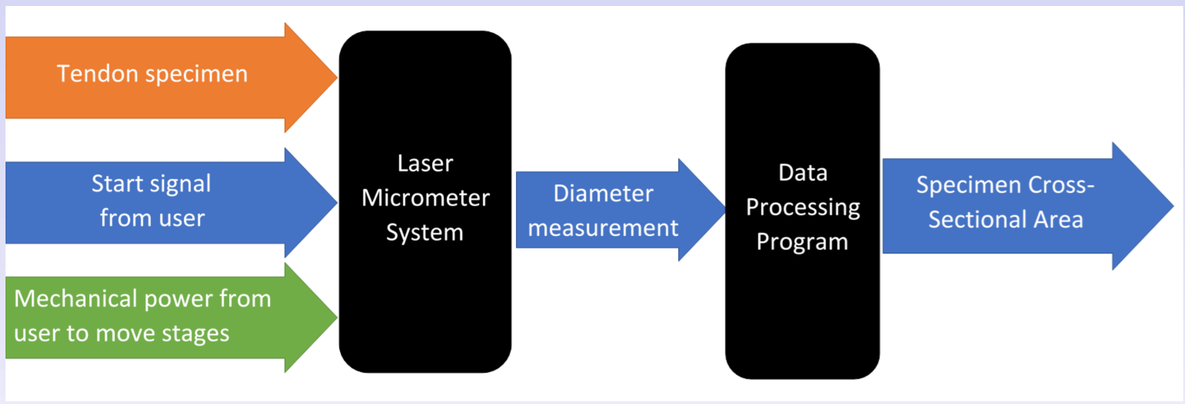

Figure 2: Functional decomposition of camera system

Final Design

- **The final design was assembled using mostly off the shelf optical equipment with some custom machining to mount the tensile grips.**

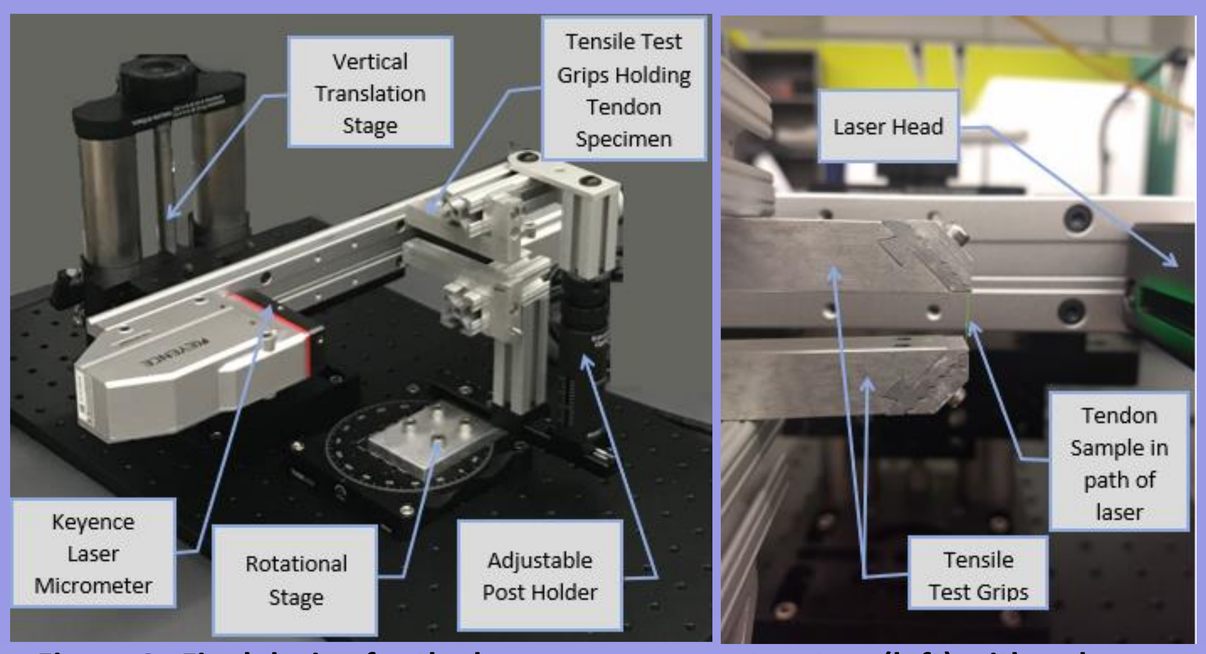

Figure 4. Final design for the laser measurement system (left) with a close up view of a tendon sample being measured (right).

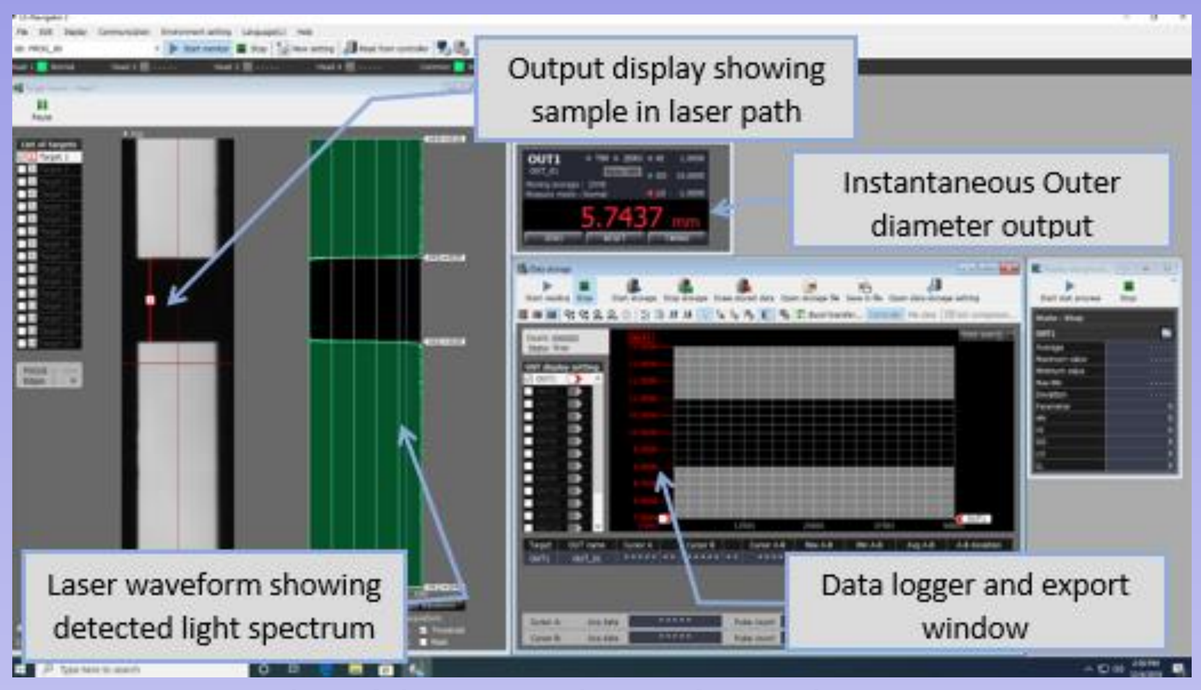

Figure 5. Screenshot of the Keyence laser software showing output measurements of the sample diameter.

Testing

Table 2. Results from testing the system's performance in relation to design specifications.

Specification	Target Value	Tested Value
Accuracy of measurement for objects of known diameter	< 0.5% error	Maximum error of 0.38%
Reliability of measurement for tendon samples	< 5 µm deviation	1.28 µm deviation (n=42)
Speed of average operation to keep sample Hydrated	< 5 min	3 min 24 sec ± 52 sec (n=15)
Speed of post-processing to calculate cross-sectional area	< 5 min	4 min 38 sec ± 11 sec (n=15)

- **Conclusion: With the successful results shown above, the final design meets all the customer needs and specifications.**

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