SIMATS ENGINEERING
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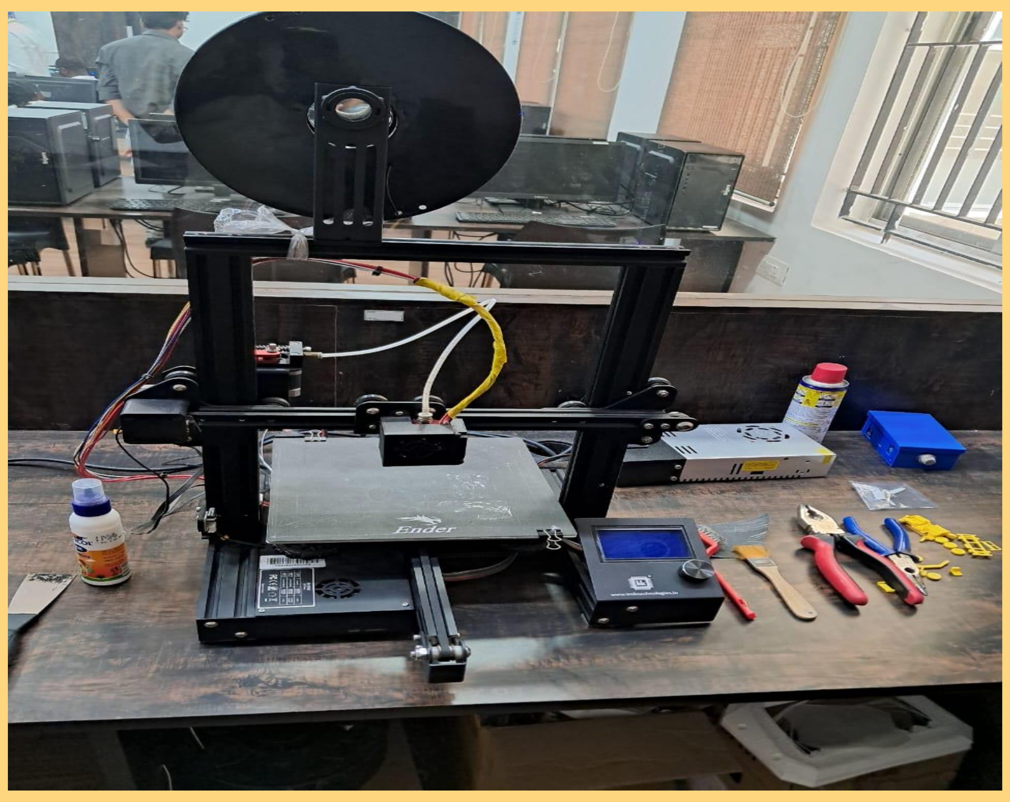
Experimentation for Achieving Enhancing Tensile Strength in 3D Printed Nylon Filament Composites: Exploring Different Infill Patterns Using a CNN Approach

INTRODUCTION

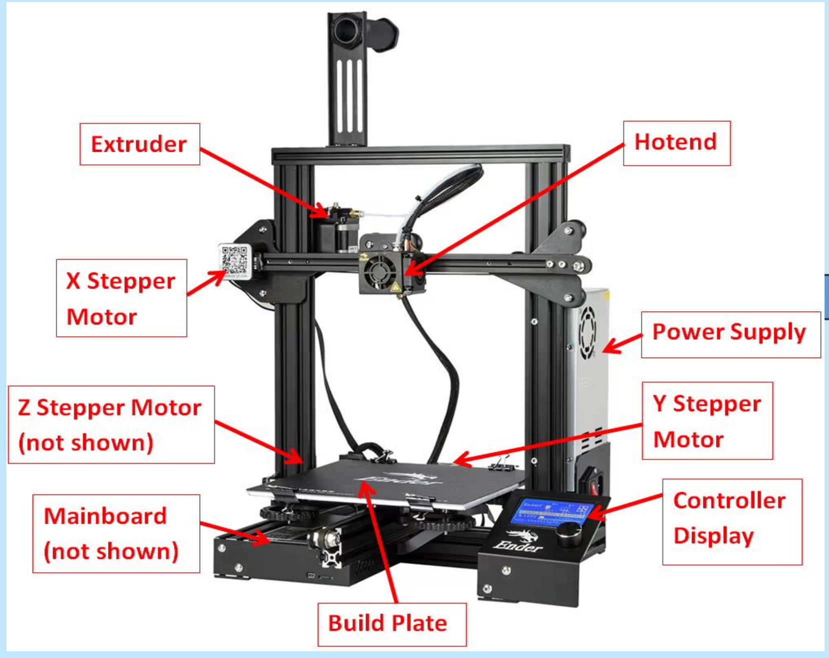
- The advancement of 3D printing technology has opened new horizons in the fabrication of composite materials, offering unparalleled control over their internal structures and mechanical properties.
- Among the various materials utilized, nylon filament stands out due to its durability, flexibility, and strength, making it an ideal candidate for high-performance applications.
- However, optimizing the mechanical properties of 3D printed objects, particularly their tensile strength, remains a significant challenge that necessitates innovative approaches.
- This study not only contributes to the theoretical understanding of material behavior in 3D printed composites but also provides practical guidelines for the production of stronger, more reliable 3D printed parts.
- The outcomes of this research could have broad implications for various industries, including automotive, aerospace, and healthcare, where high-strength materials are crucial.



FDM (fused deposition modeling)

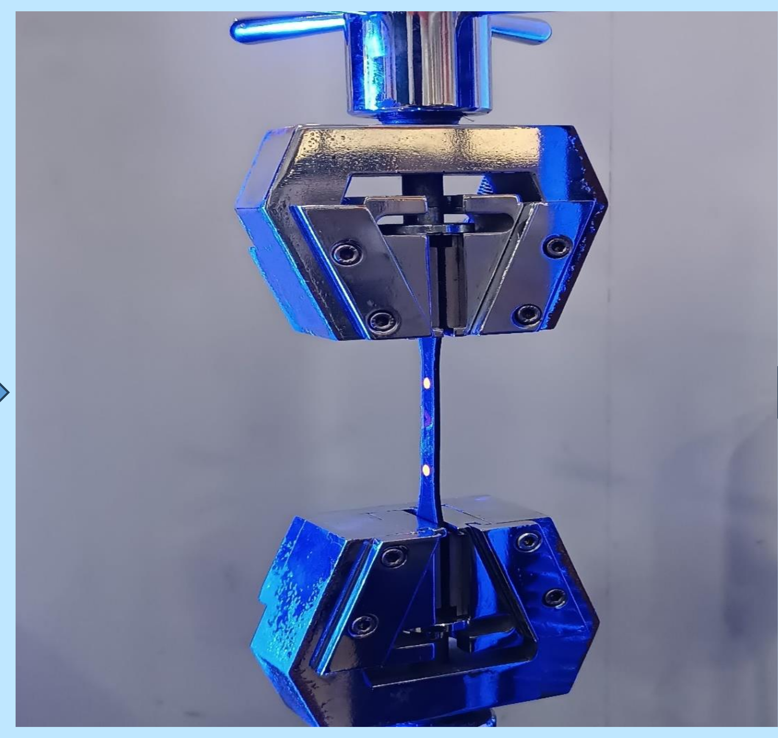
MATERIALS AND METHODS

3D Printer Nylon Filaments

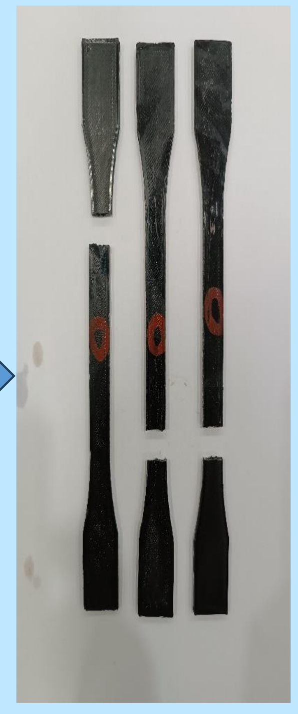


A schematic of the FDM printing process

3D Printed Nylon Filament Plates



Tensile



Product

RESULTS

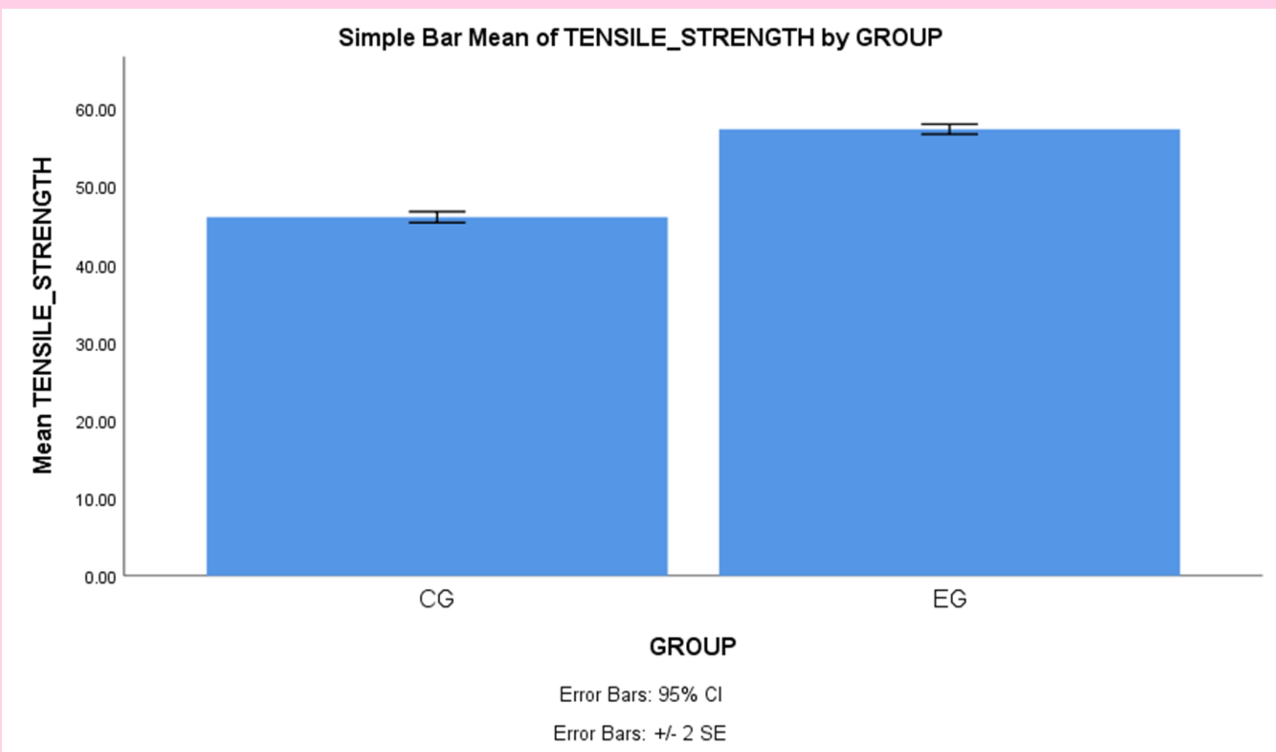


Fig: Bar Chart representing the comparison of Tensile Strength for CG represents Nylon Filament

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Tensile strength	Equal variances assumed	0.239	0.030	-23.822	38	0.000	-11.30000	0.47434	-12.26025	-10.33975
	Equal variances not assumed			-23.822	37.637	0.000	-11.30000	0.47434	-12.26056	-10.33944

Table: Independent sample T-Test for Hardness Strength for analysis of samples for Tensile Strength for Nylon Filament

DISCUSSION AND CONCLUSION

- Based on T-test Statistical analysis, the significance value of p=0.030 (independent sample T - test p<0.05) is obtained and shows that there is a statistical significant difference between the group 1 and group 2.
- Overall , the accuracy of the compression strength is 81.15 % and it is better than the line infill pattern.
  - Control group mean difference Tensile strength of = 46.5 (MPa)
  - Experimental group mean difference Tensile strength of = 57.3 (MPa)
  - Obtained p-value = 0.030
- Future work should focus on expanding the variety of materials tested and exploring the integration of other computational models that could further refine the selection and optimization of infill patterns.
- Additionally, real-world applications of these optimized structures should be investigated to validate their effectiveness in operational environments.
- This study underscores the transformative potential of integrating advanced computational techniques, like CNNs, into the field of 3D printing, paving the way for smarter manufacturing processes and the development of materials that are not only stronger but also more sustainable and cost-effective.

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