

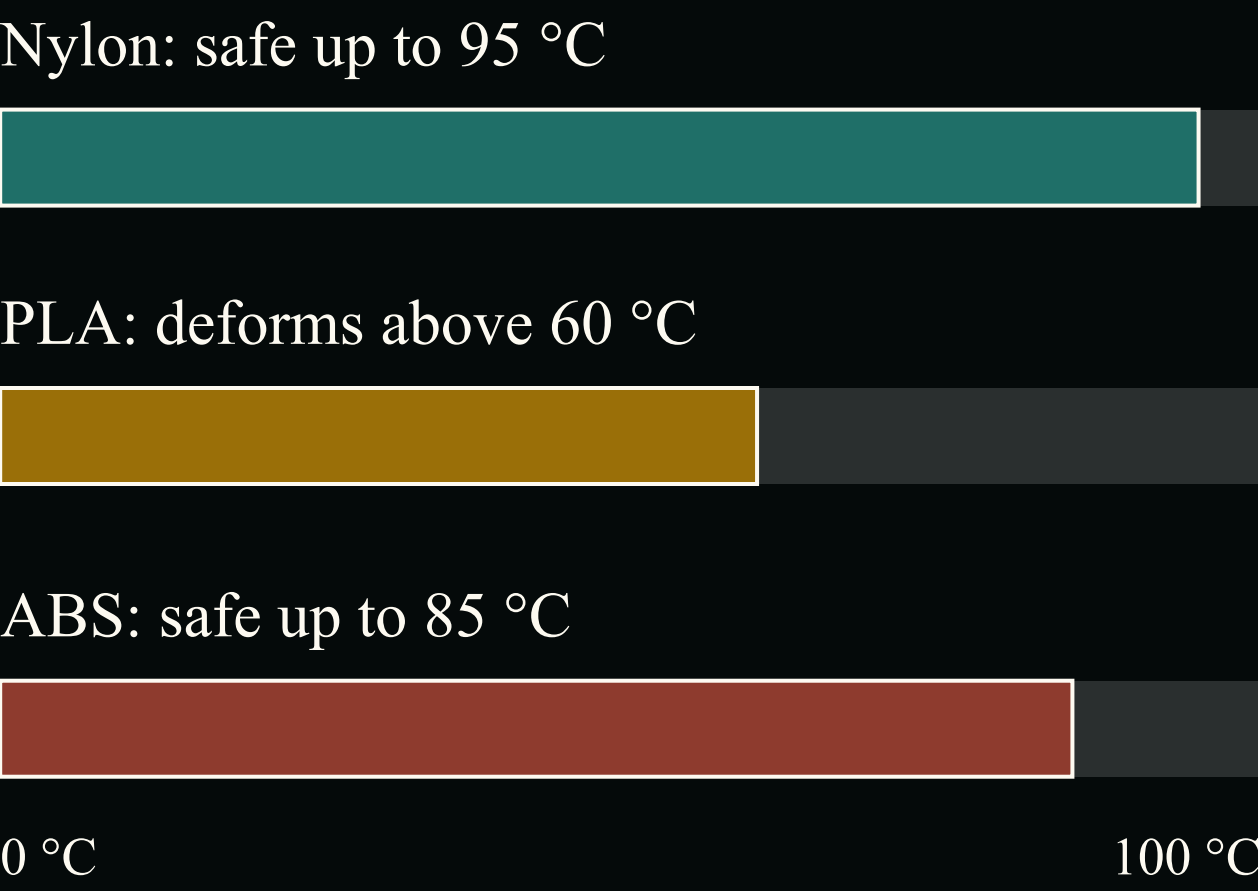
Abstract

Small DC motors can now be 3D-printed quickly and cheaply, but little is known about how the printing plastic affects how well they work. This paper compared brushed DC motors made from PLA, ABS and Nylon (PA-12) using computer simulations with analysis of heat, stress, wear and motor output, plus printed test pieces to check accuracy. Nylon was fastest, most efficient, most heat-resistant and wore least. PLA was the most accurate and cheapest to print, but softens above 60 °C.

Colour key

-  Nylon (PA-12)
-  PLA (polylactic acid)
-  ABS

Heat tolerance



Keywords

3D printing (FDM) · DC motor simulation · PLA · ABS · Nylon · finite element analysis

Comparative Simulation and Performance Analysis of 3D Printed DC Motors Fabricated from PLA, ABS, and Nylon: Mechanical, Thermal, and Electromagnetic Evaluation

Aadi Gupta

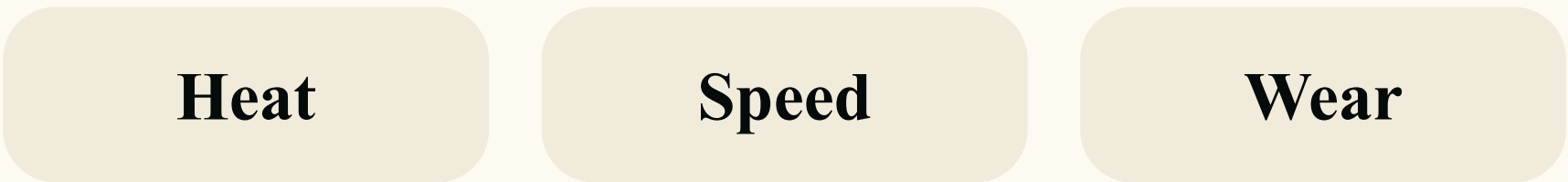
Introduction

3D printing lets engineers build small electric motors quickly and cheaply. But motors get hot, spin fast and rub against themselves for thousands of cycles, hence the plastic matters.

Research question: Which common printing plastic- PLA, ABS or Nylon- makes the best small brushed DC motor?

Few studies compare how these plastics change a motor’s speed, efficiency, heat tolerance and wear. The study helps students, makers and engineers pick the right material.

A motor plastic must survive:



Methods

One motor design was modelled three times, changing only the printed plastic.

- 1

Design
Same motor; printed parts in PLA, ABS or Nylon
- 2

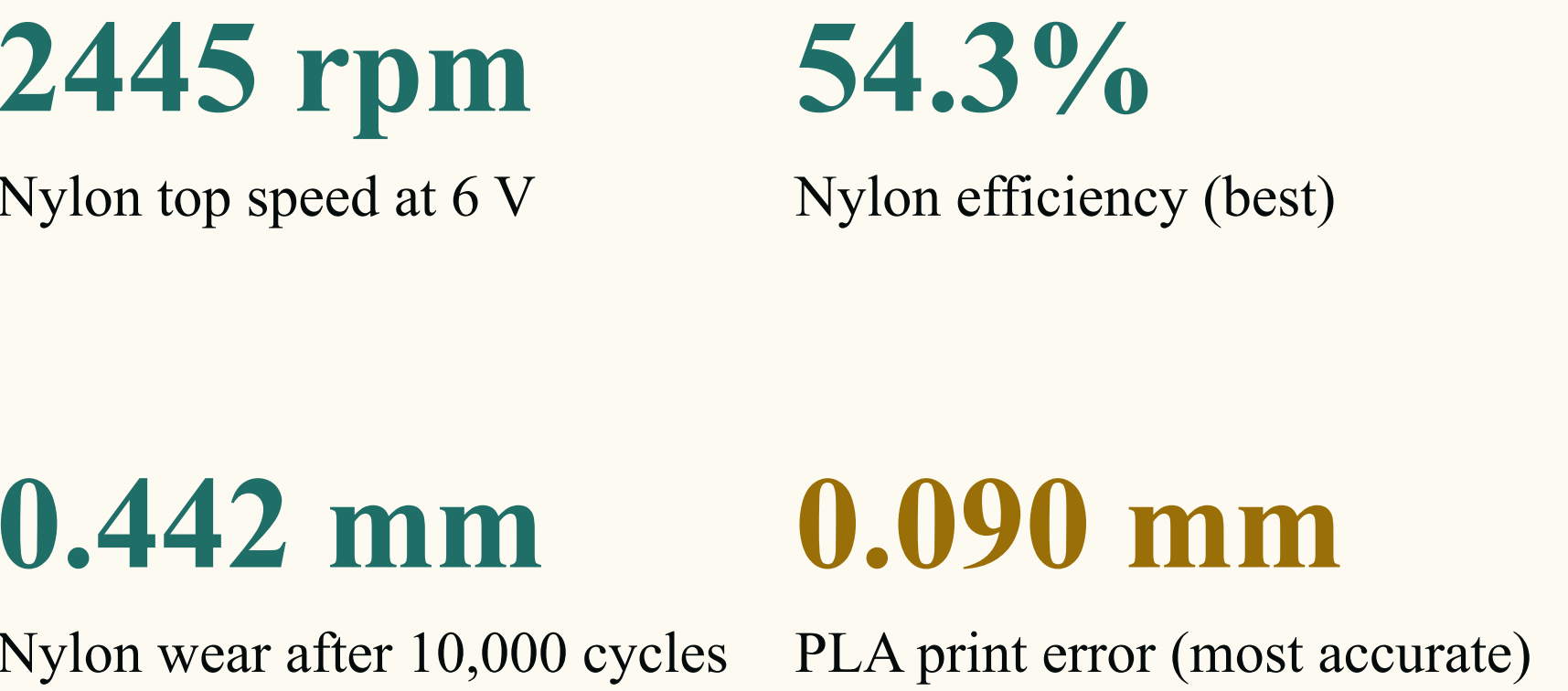
Heat & stress simulation
ANSYS Mechanical 2024 R1: temperature, bending and wear
- 3

Motor performance model
Predicted speed, torque and efficiency
- 4

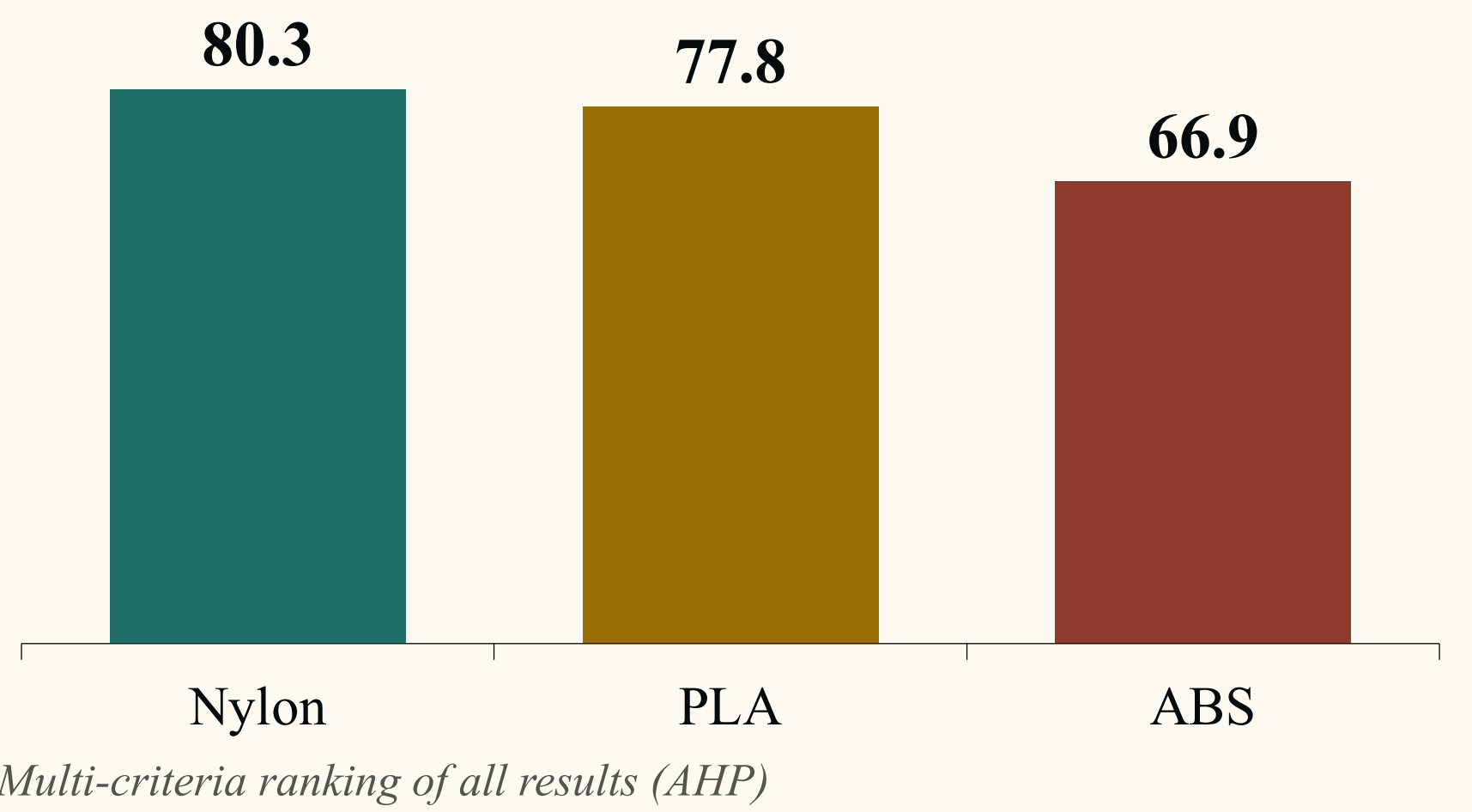
Print & measure
Printed test pieces checked for size accuracy
- 5

Rank
Analytic Hierarchy Process combined all results into one score

Results



Overall score (out of 100)



Best material for each criterion

Criterion	Winner
Speed & efficiency	Nylon
Heat tolerance	Nylon
Wear resistance	Nylon
Print accuracy	PLA
Low cost	PLA

ABS was in the middle but did not win any criterion.

Discussion

Nylon was best because it stays stable when hot (safe to 95 °C) and is tough, so it wears less and the motor keeps its shape and efficiency for longer.

PLA printed most accurately and cheaply, but bends noticeably above 60 °C.

ABS was a middle-ground option with no clear advantage.

Why it matters

Cheap, accurate PLA motors could become low-cost learning kits, helping children in under-resourced regions learn electronics hands-on.

Conclusion

The printing plastic clearly changes how a 3D-printed motor performs.

- Nylon

for high-performance or long-life motors
- PLA

for low-cost motors that run briefly or stay below 60 °C

Next steps: build and test real printed motors to confirm these simulations, and try stronger or heat-resistant filaments.

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