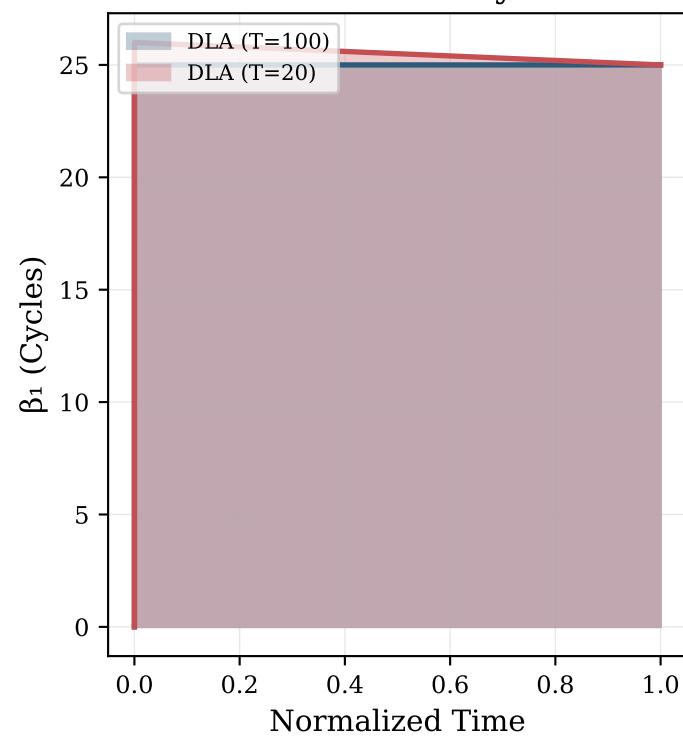
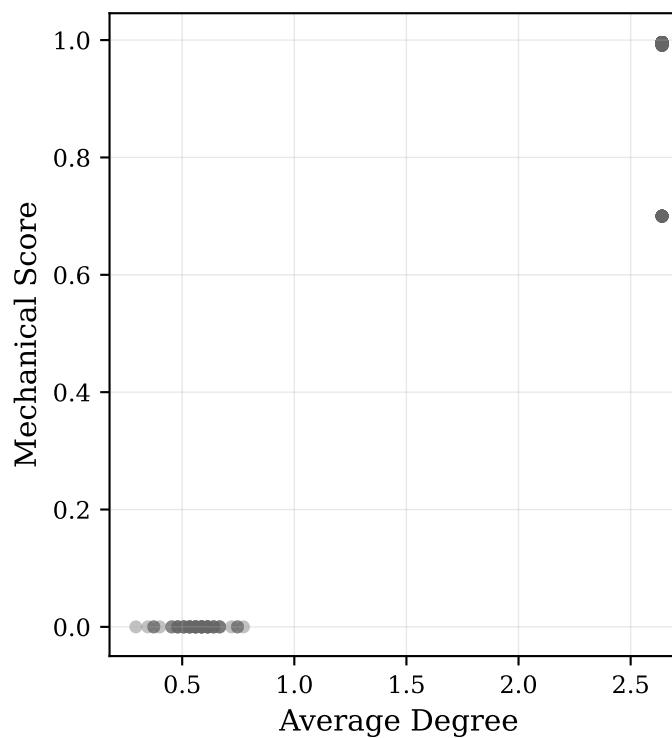


# Assembly-Net: Why Assembly History Matters

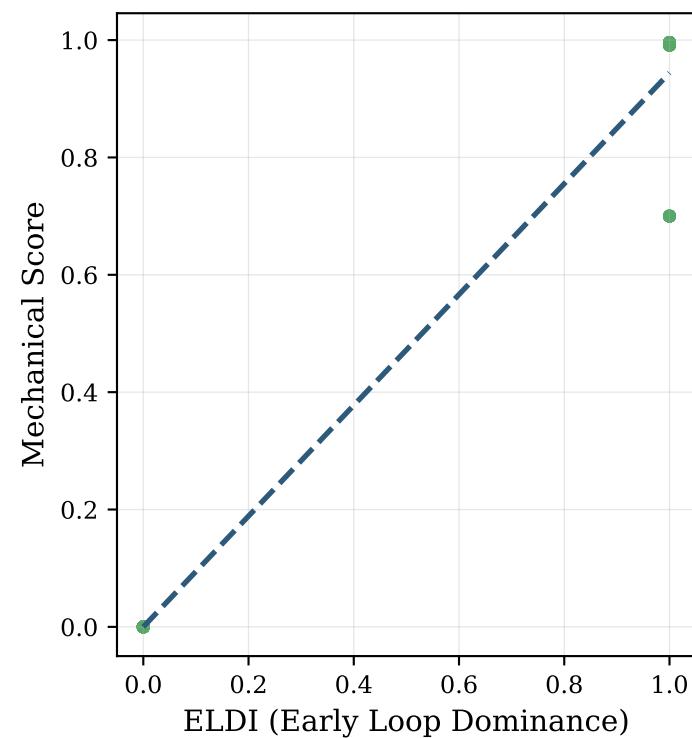
**(a) Same Final Graph, Different Assembly Paths**



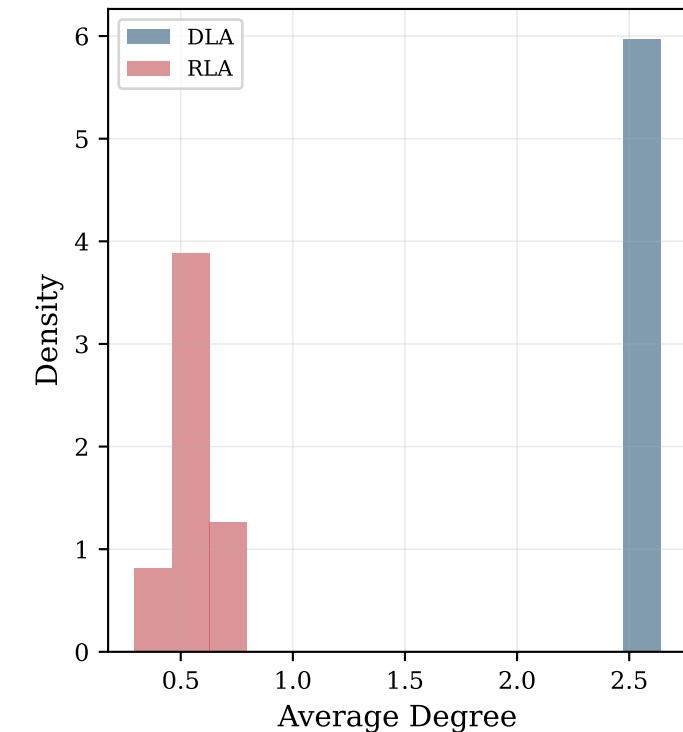
**(b) Simple Stats Fail**  
 $r = 0.98$



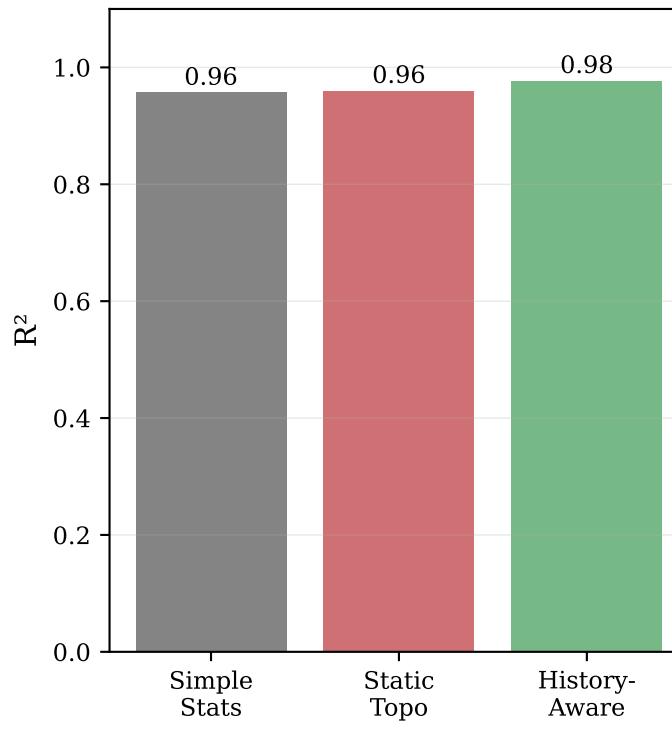
**(c) History-Aware Succeeds**  
 $r = 0.98$



**(d) Regimes Overlap in Simple Statistics**



**(e) Model Comparison**



**(f) Summary**

**KEY FINDINGS**

- IMPOSSIBILITY:** Same final structure can have different properties
- NAÏVE FIXES FAIL:** Simple statistics cannot resolve the ambiguity
- SOLUTION:** History-aware topological descriptors (ELDI) capture assembly path information

Under assumptions A1-A5, static models are provably insufficient.