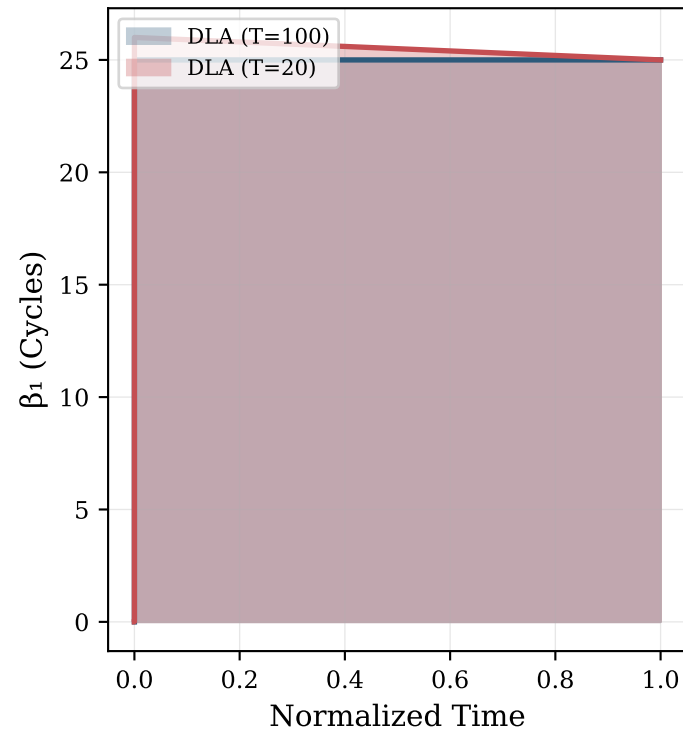
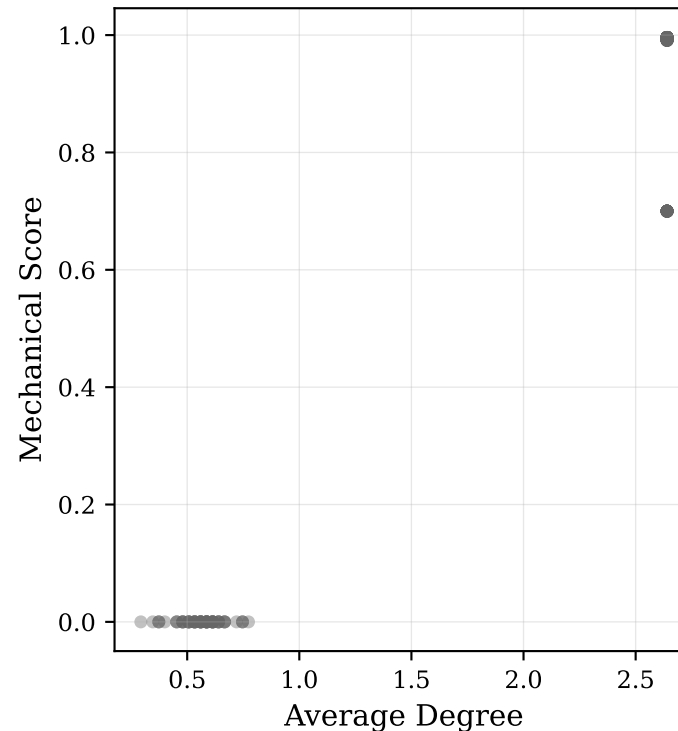


# Assembly-Net: Why Assembly History Matters

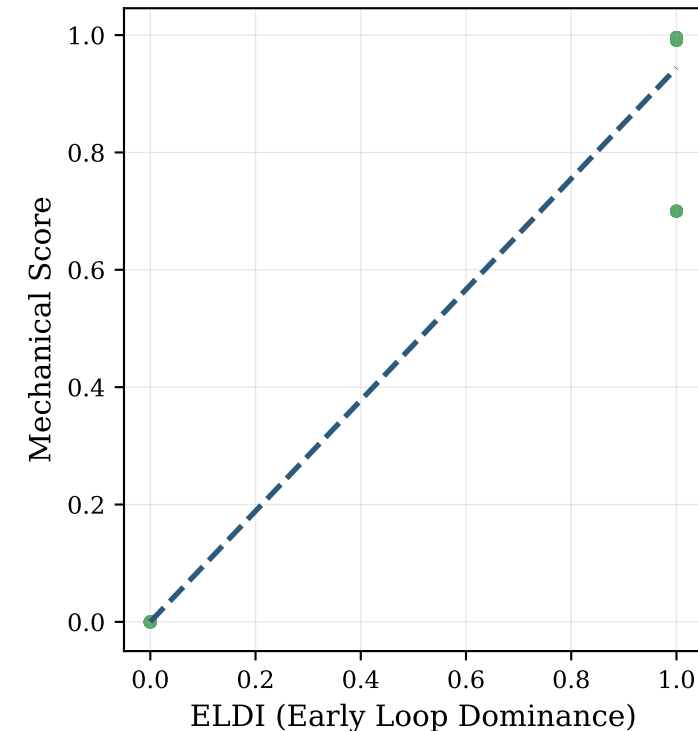
**(a) Same Final Graph,  
Different Assembly Paths**



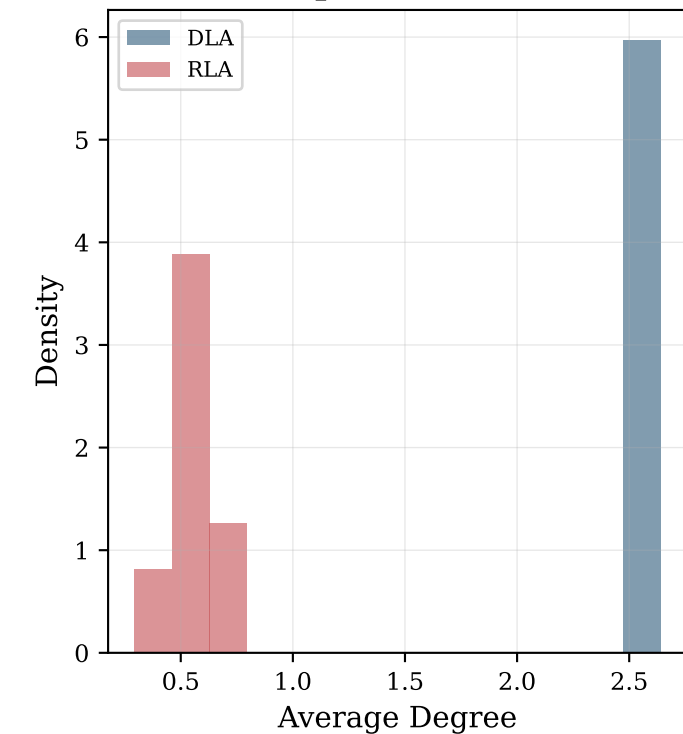
**(b) Simple Stats Fail**  
 $r = 0.98$



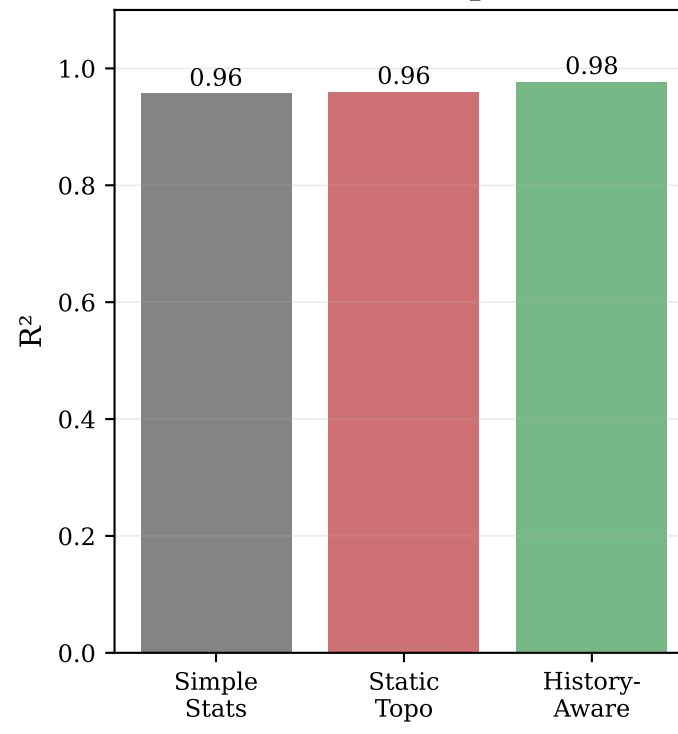
**(c) History-Aware Succeeds**  
 $r = 0.98$



**(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.