

Team FZZH



StrMQA: A Structural Models-Based Method for Assessing Protein Complex Interfaces and Global Structures

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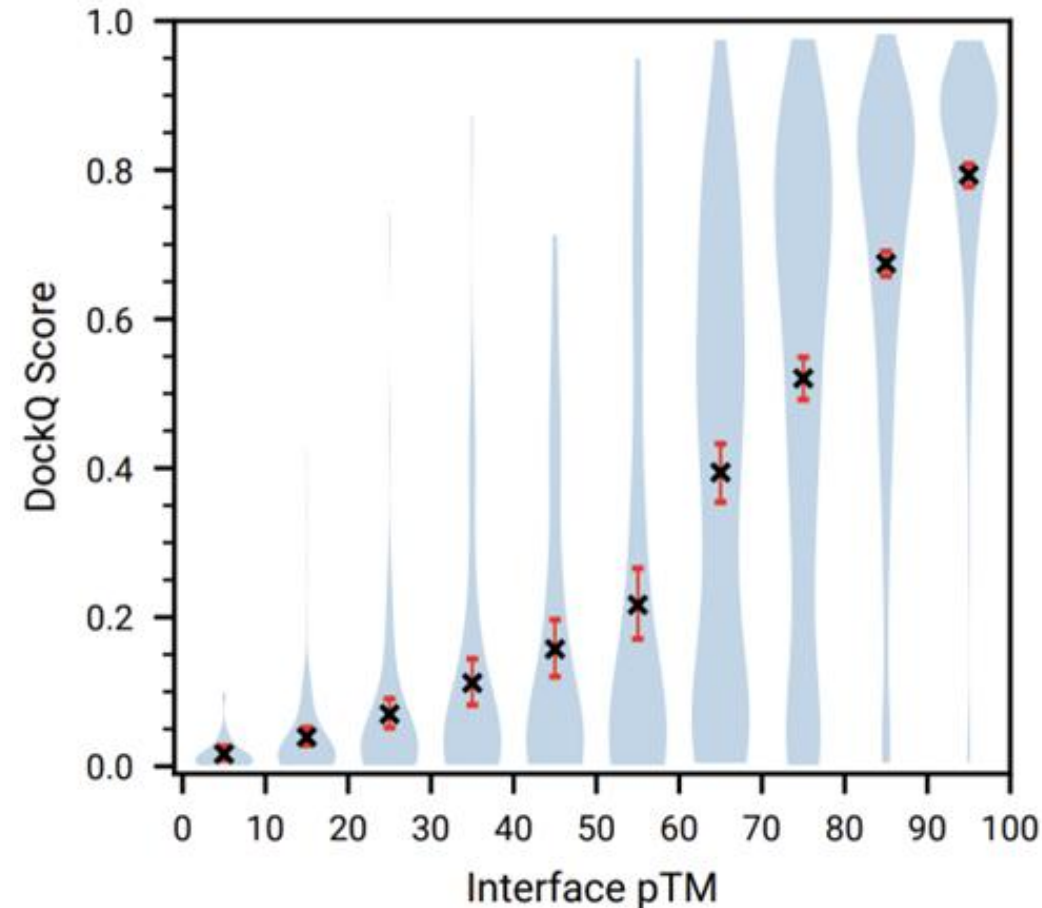
CASP16, December 2nd, 2024

Motivation:

- ❑ High-confidence models strongly correlate with actual accuracy.
- ❑ Medium-confidence models show considerable variability in actual accuracy.



High-confidence models can serve as references to adjust overall estimations.



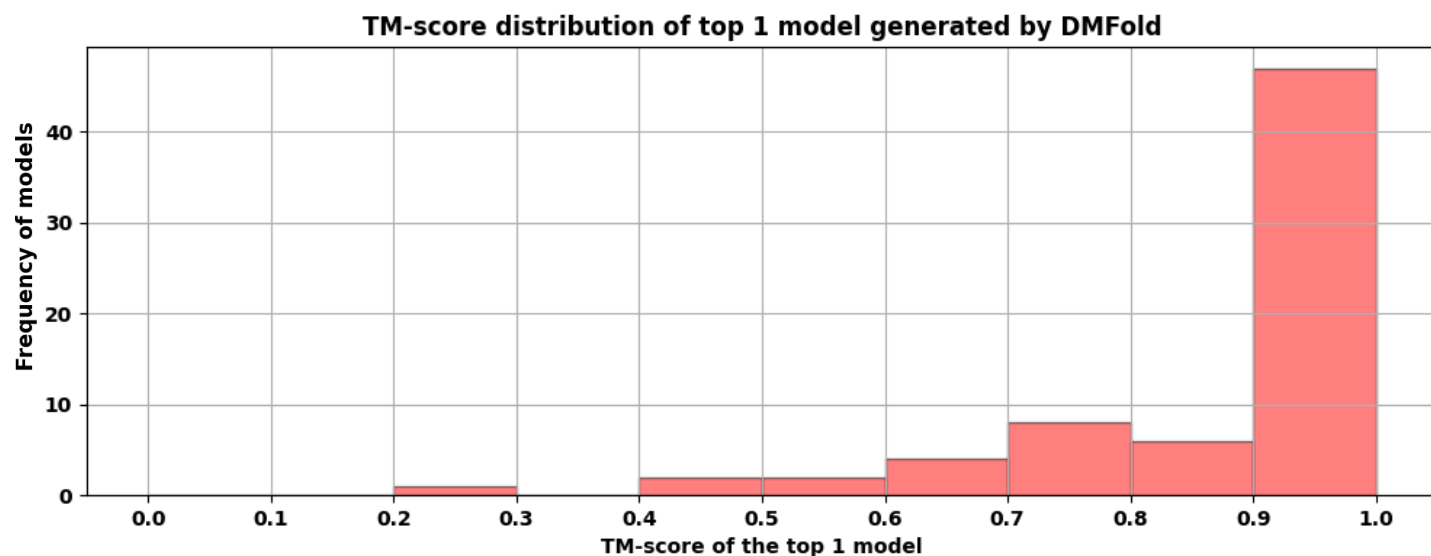
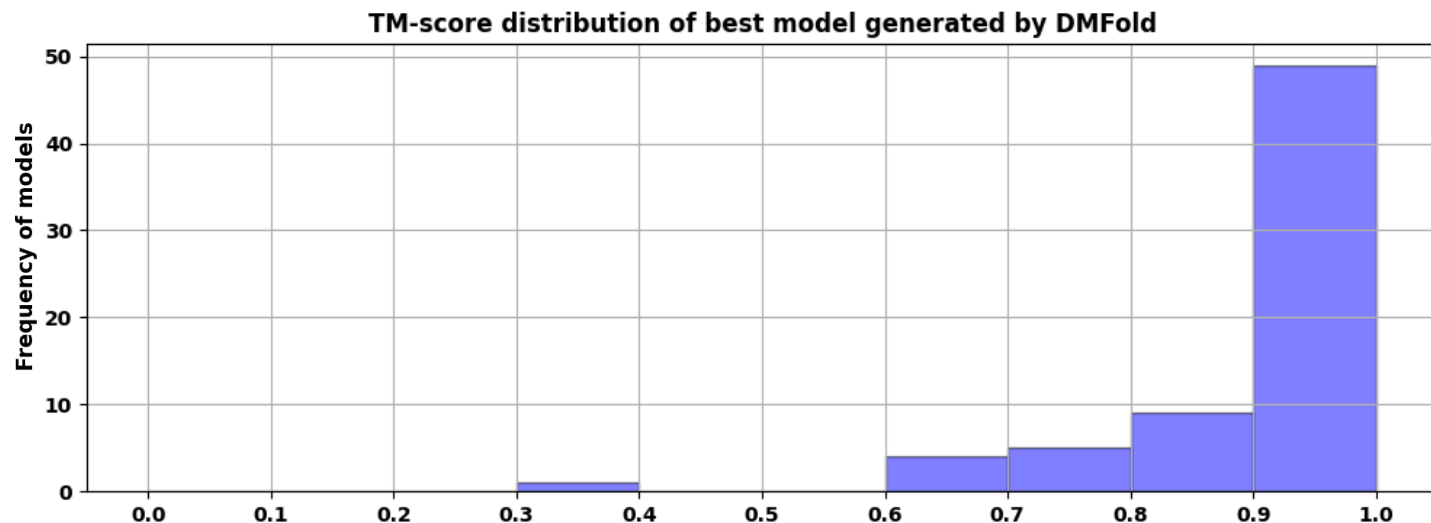
The figure comes from “Protein complex prediction with AlphaFold-Multimer”, bioRxiv 2021.10.04.463034, **Figure 3**

Feasibility

- ❑ For **>85%** of the targets, the TM-score of the best DMFold model is greater than **0.80**;
- ❑ For **>75%** of the targets, the TM-score of the top 1 model of DMFold is greater than **0.80**.



The high-confidence DMFold models can serve as reference structures.

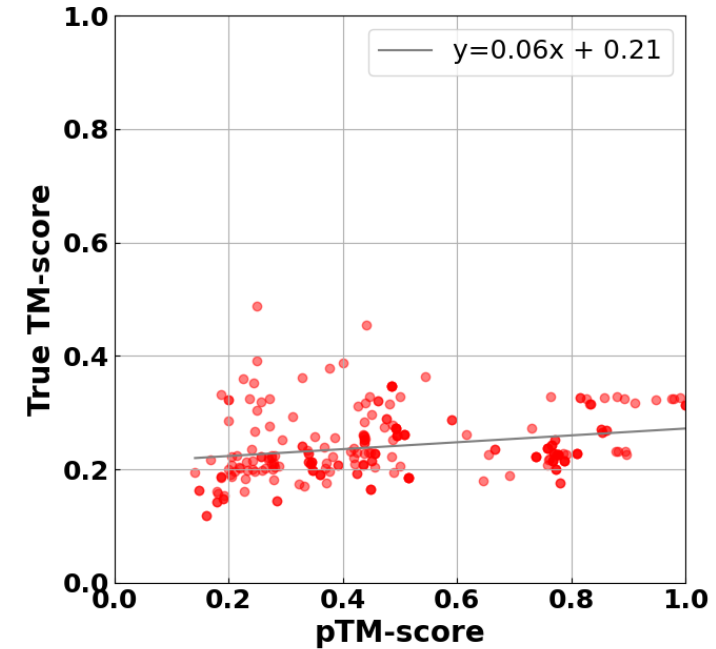
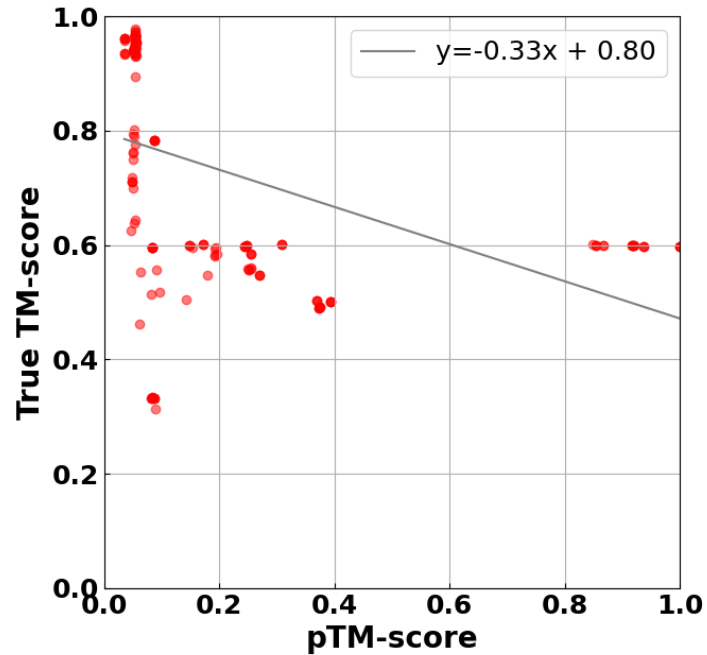


Benchmark set: 76 multimers from CASPs 12 to 15

Potential issues

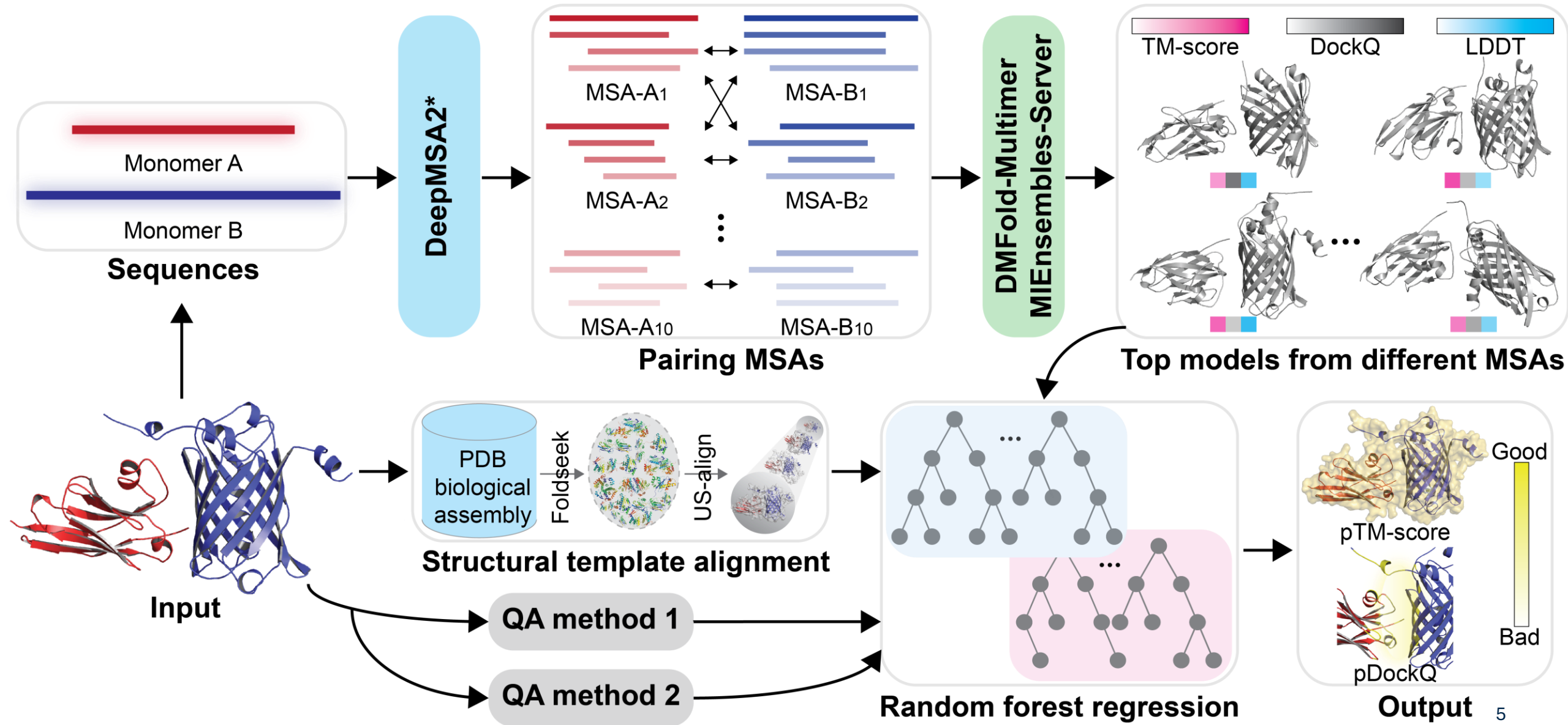
❑ Incorrect ranking models as references

❑ No high-quality models as references



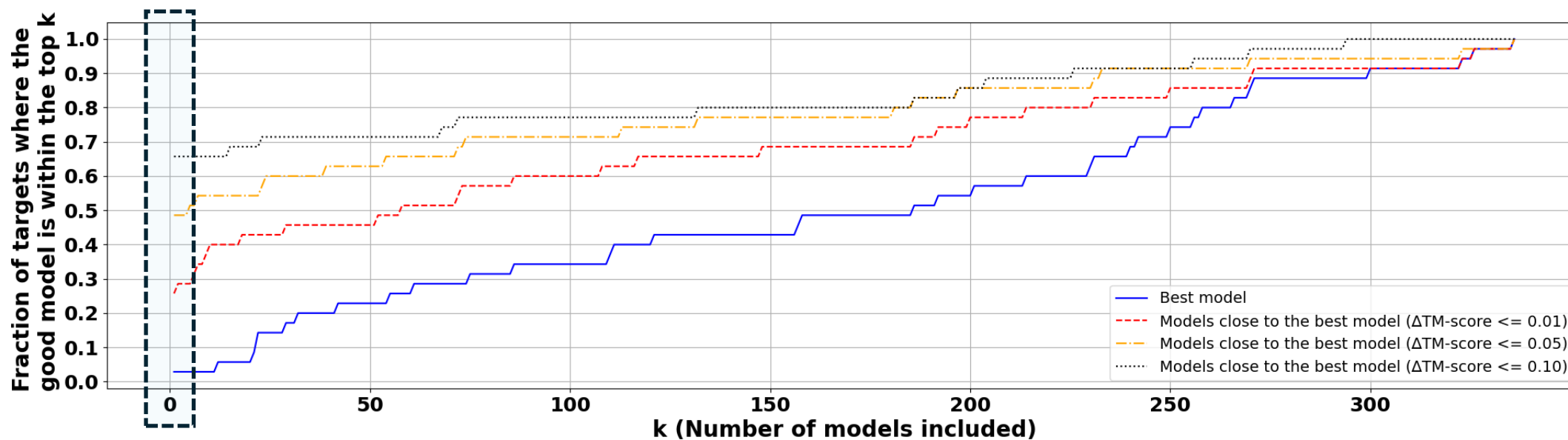
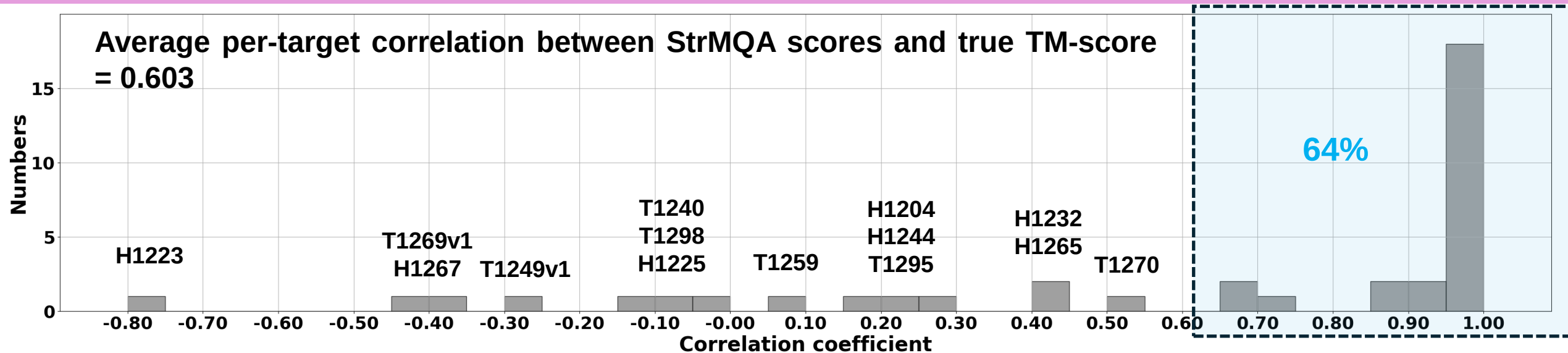
Solution: high-quality models from different sources, different types of QA methods and similarity of structural template

StrMQA pipeline for CASP16



Overall StrMQA results on multimers

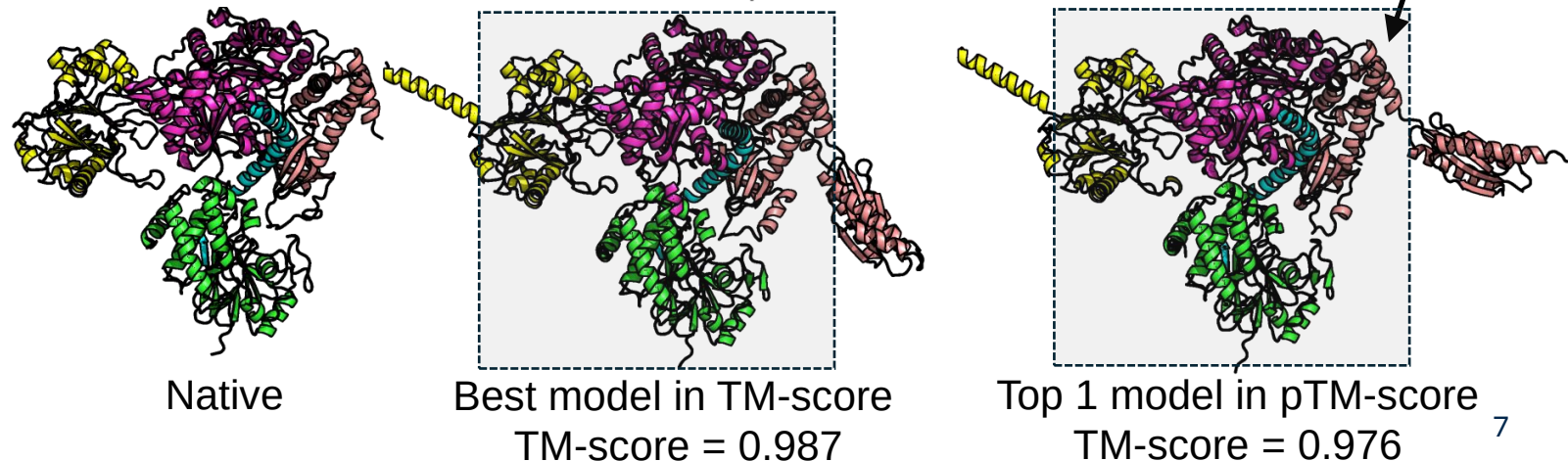
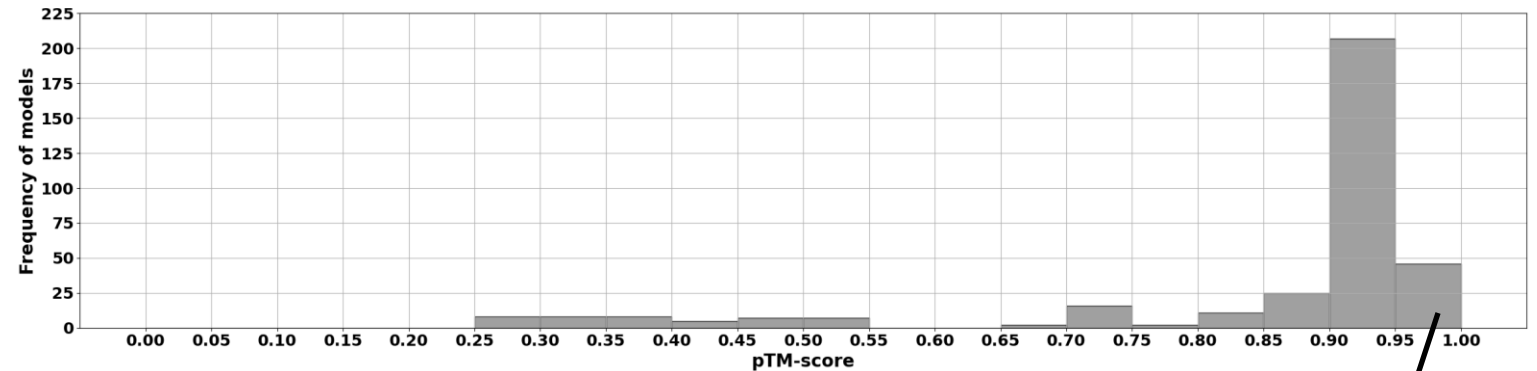
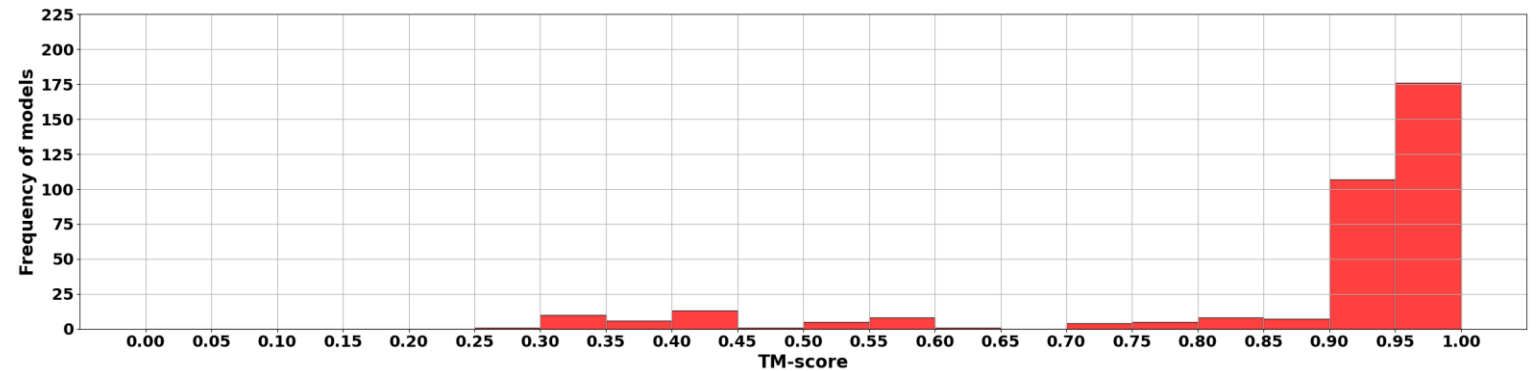
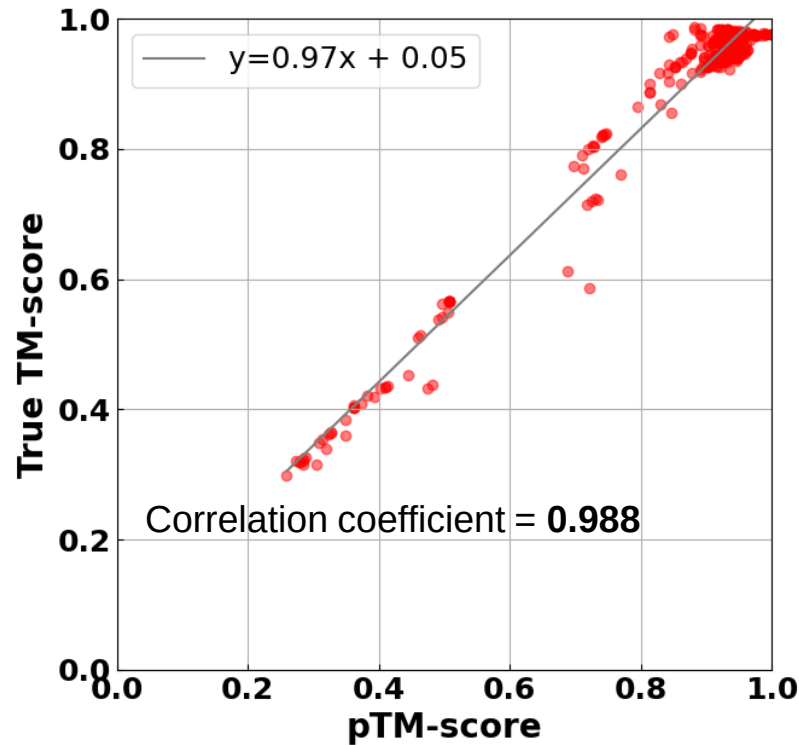
Distribution of per-target Pearson correlation of global quality on CASP16 models of 39 Multimers



Case study: H1213 | global fold accuracy estimation

Model information:

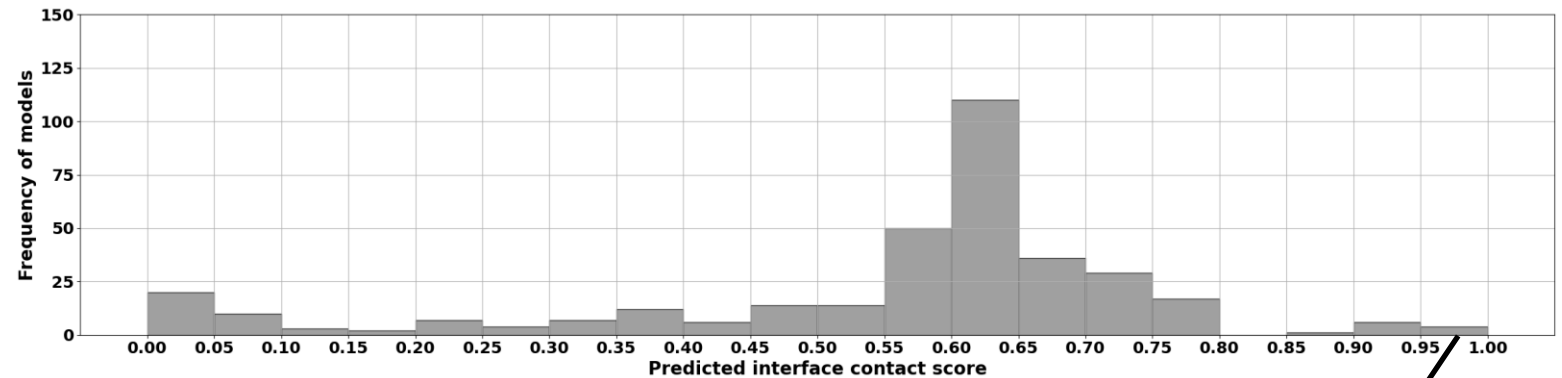
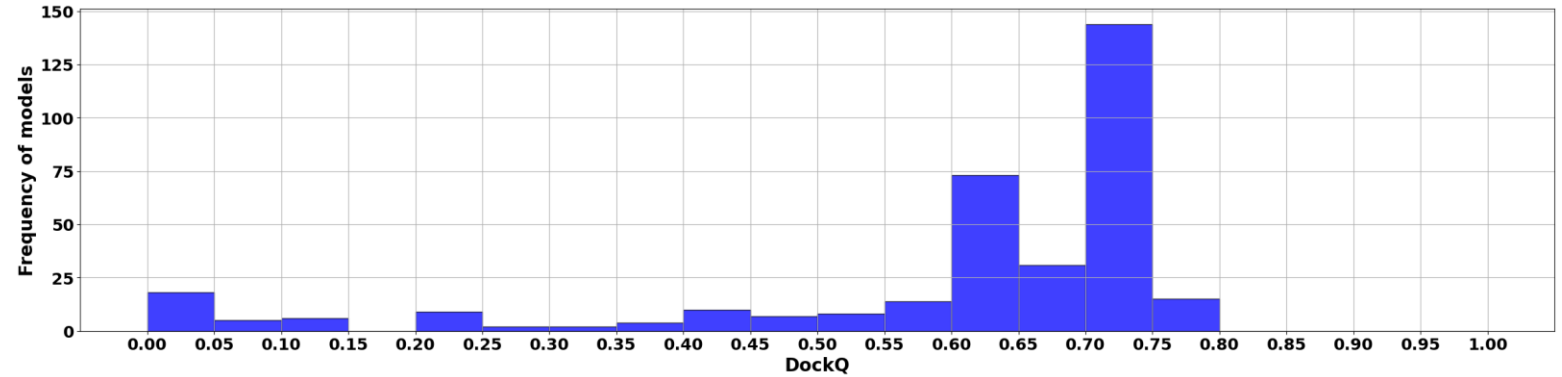
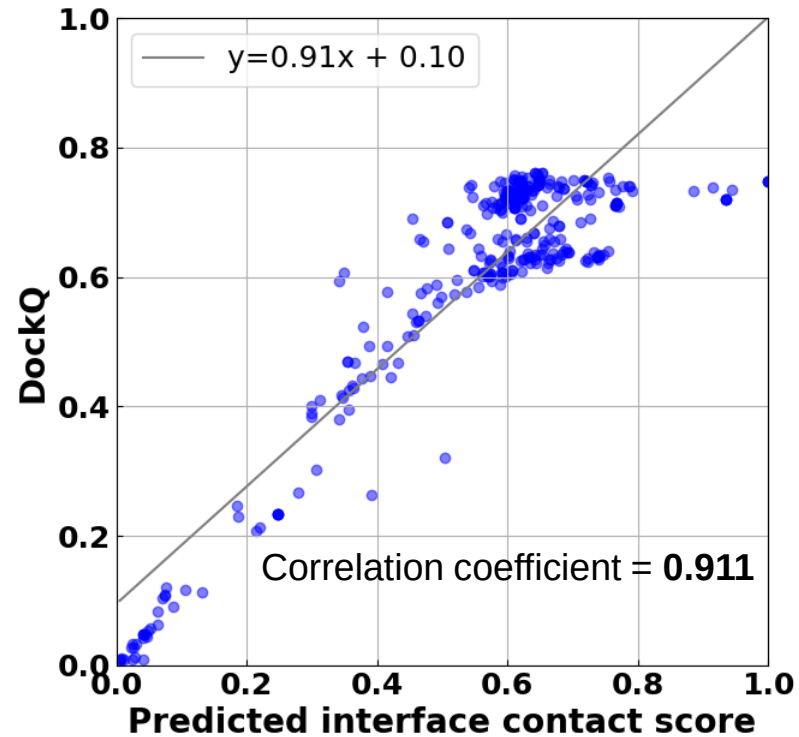
Human swine fever virus



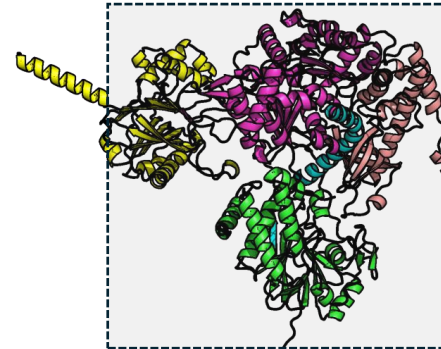
Case study: H1213 | interface accuracy estimation

Model information:

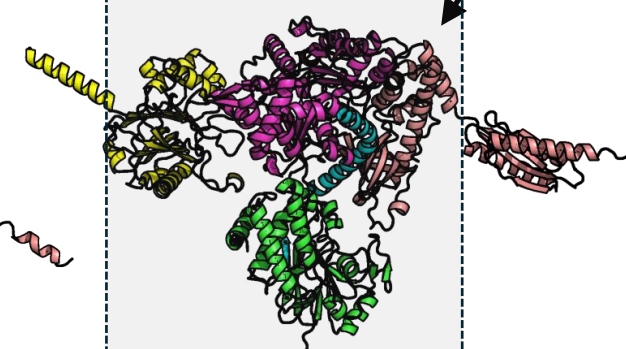
Human swine fever virus



Native

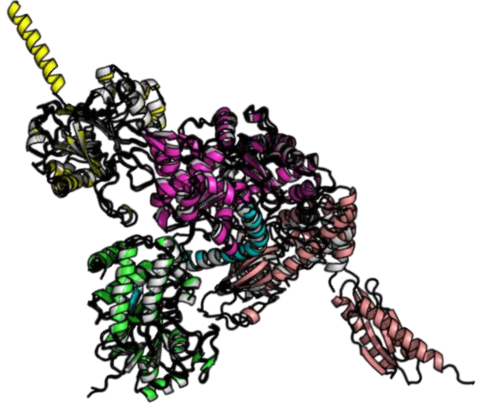


Best model in pICS
DockQ = 0.760

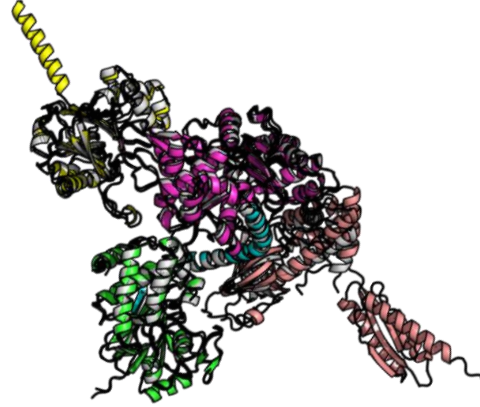


Top 1 model in pICS
DockQ = 0.748

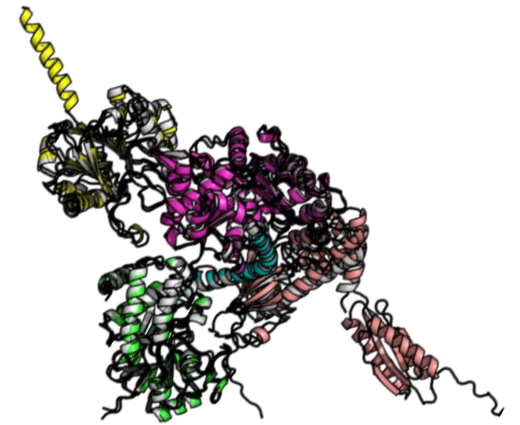
Case study: H1213 | what's right?



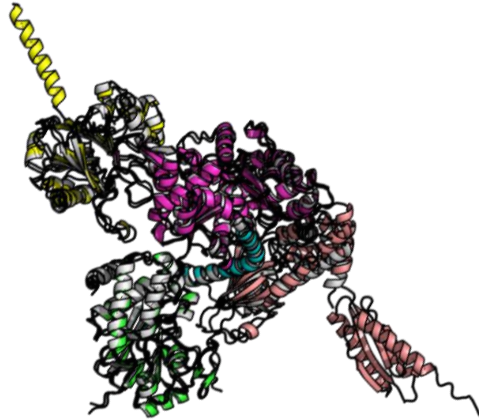
Top 1 DMFold model
TM-score: 0.976
DockQ: 0.748
LDDT: 0.908



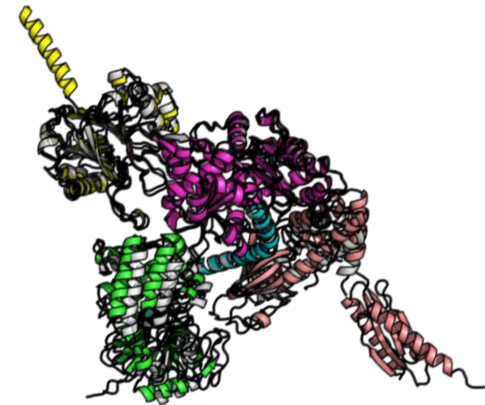
Top 2 DMFold model
TM-score: 0.975
DockQ: 0.720
LDDT: 0.907



Top 3 DMFold model
TM-score: 0.976
DockQ: 0.715
LDDT: 0.908



Top 4 DMFold model
TM-score: 0.975
DockQ: 0.710
LDDT: 0.907

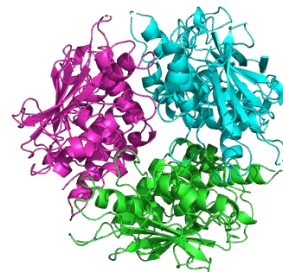
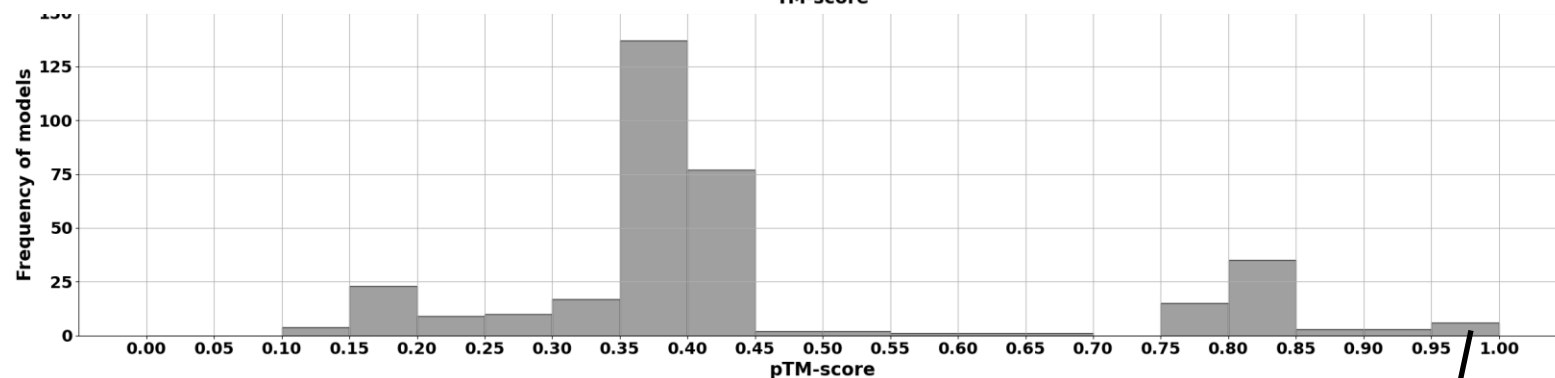
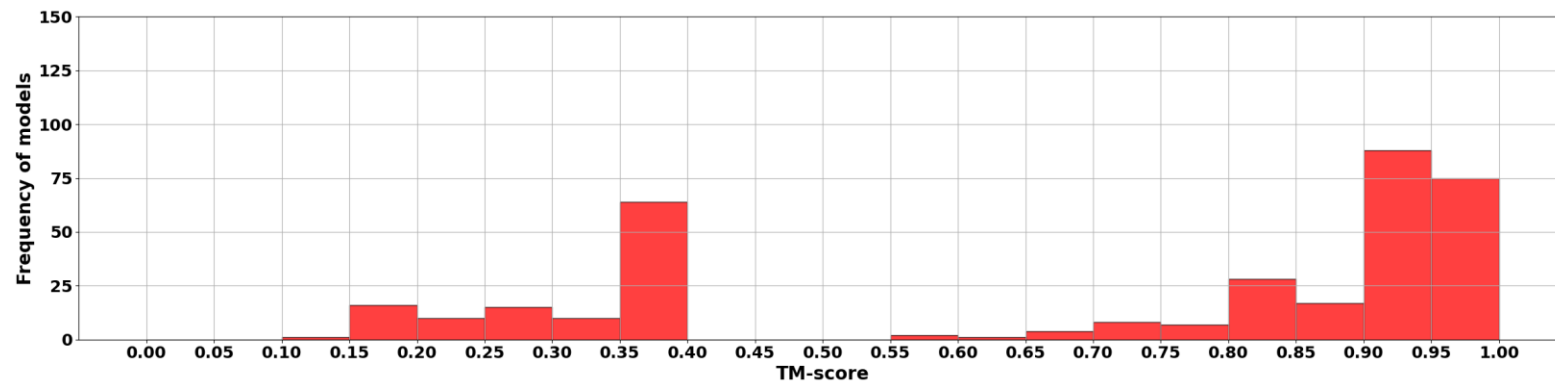
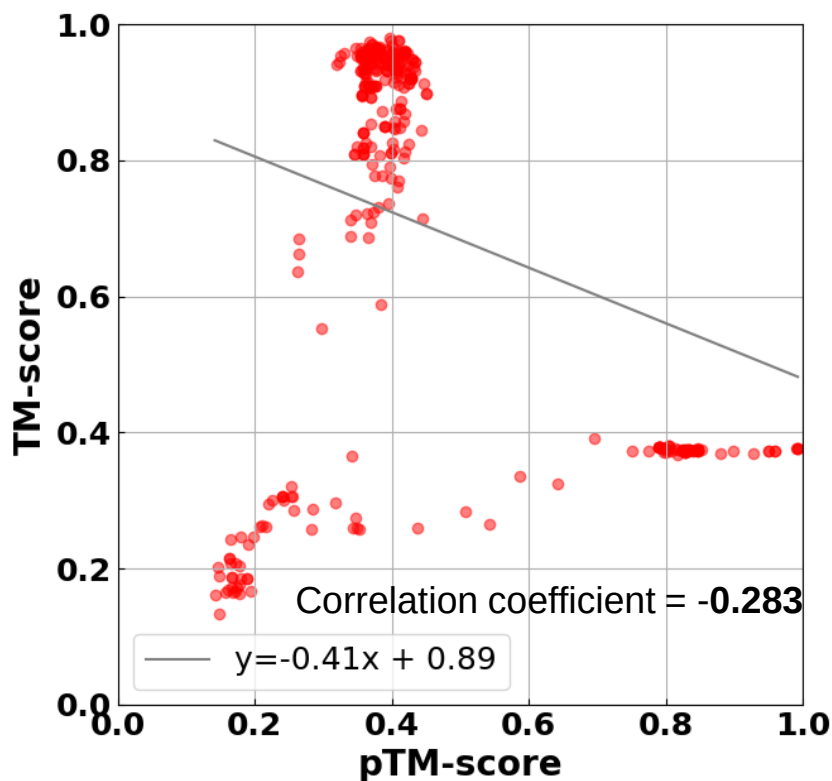


Top 5 DMFold model
TM-score: 0.943
DockQ: 0.630
LDDT: 0.899

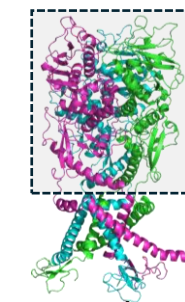
Case study: T1249v1 | global fold accuracy estimation

Model information:

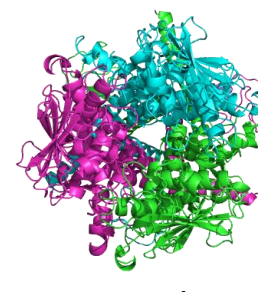
Arenaviral spike complex



Native

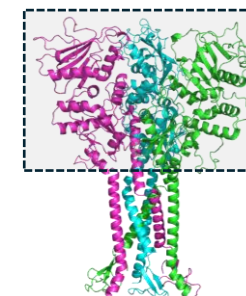


Front view

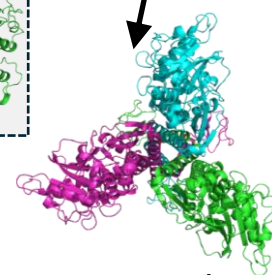


Top view

TM-score = 0.979
Best model



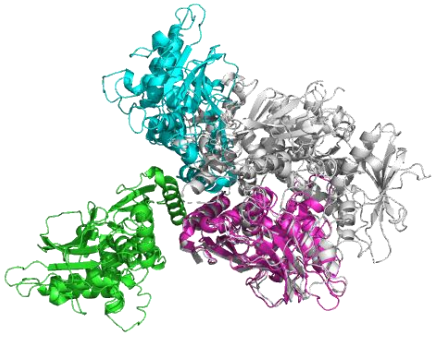
Front view



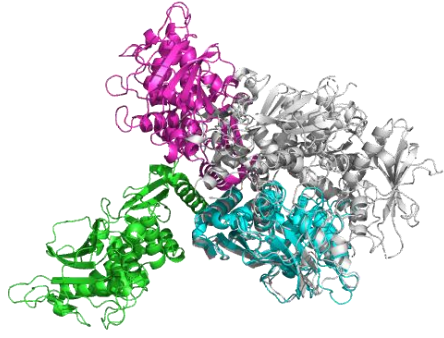
Top view

TM-score = 0.377₁₀
Top1 model

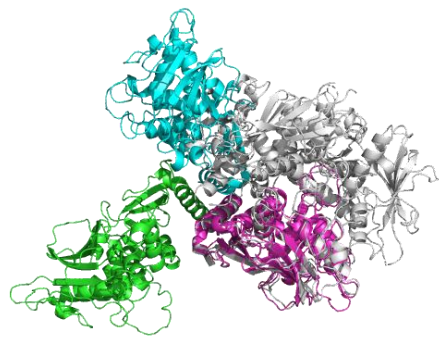
Case study: T1249v1 | what's wrong?



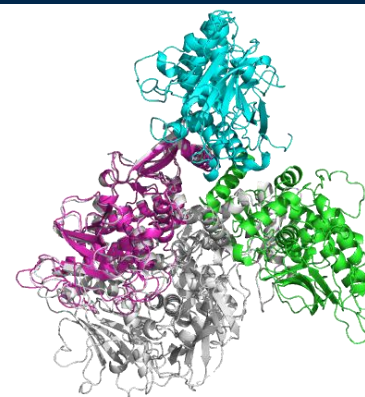
Top 1 DMFold model
TM-score: 0.337
DockQ: 0.009
LDDT: 0.742



Top 2 DMFold model
TM-score: 0.337
DockQ: 0.009
LDDT: 0.724



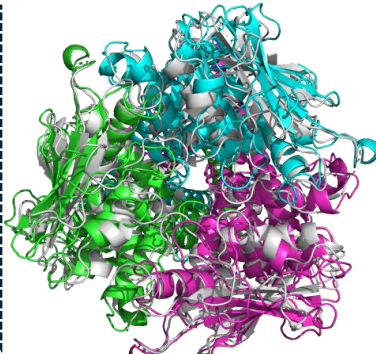
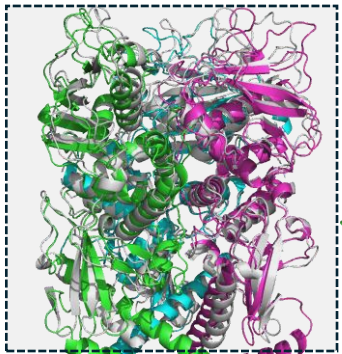
Top 3 DMFold model
TM-score: 0.375
DockQ: 0.013
LDDT: 0.727



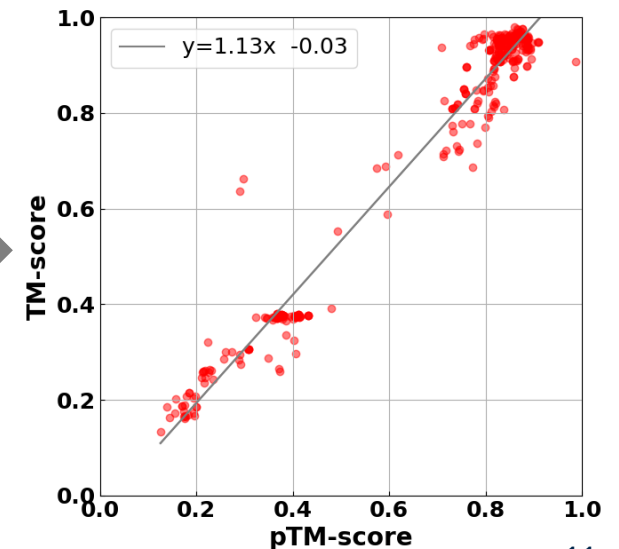
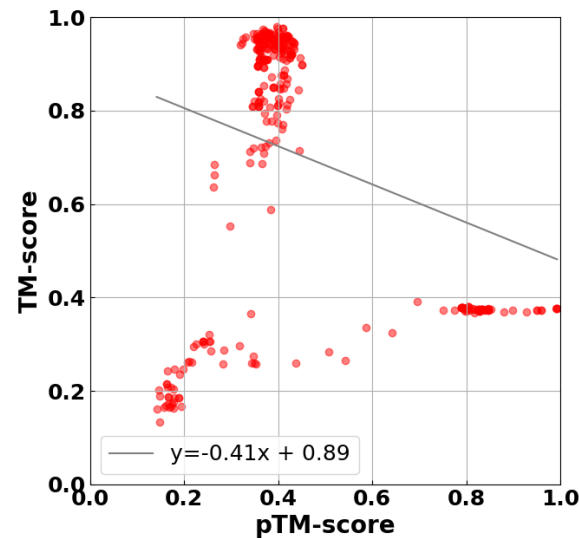
Top 4 DMFold model
TM-score: 0.378
DockQ: 0.015
LDDT: 0.734



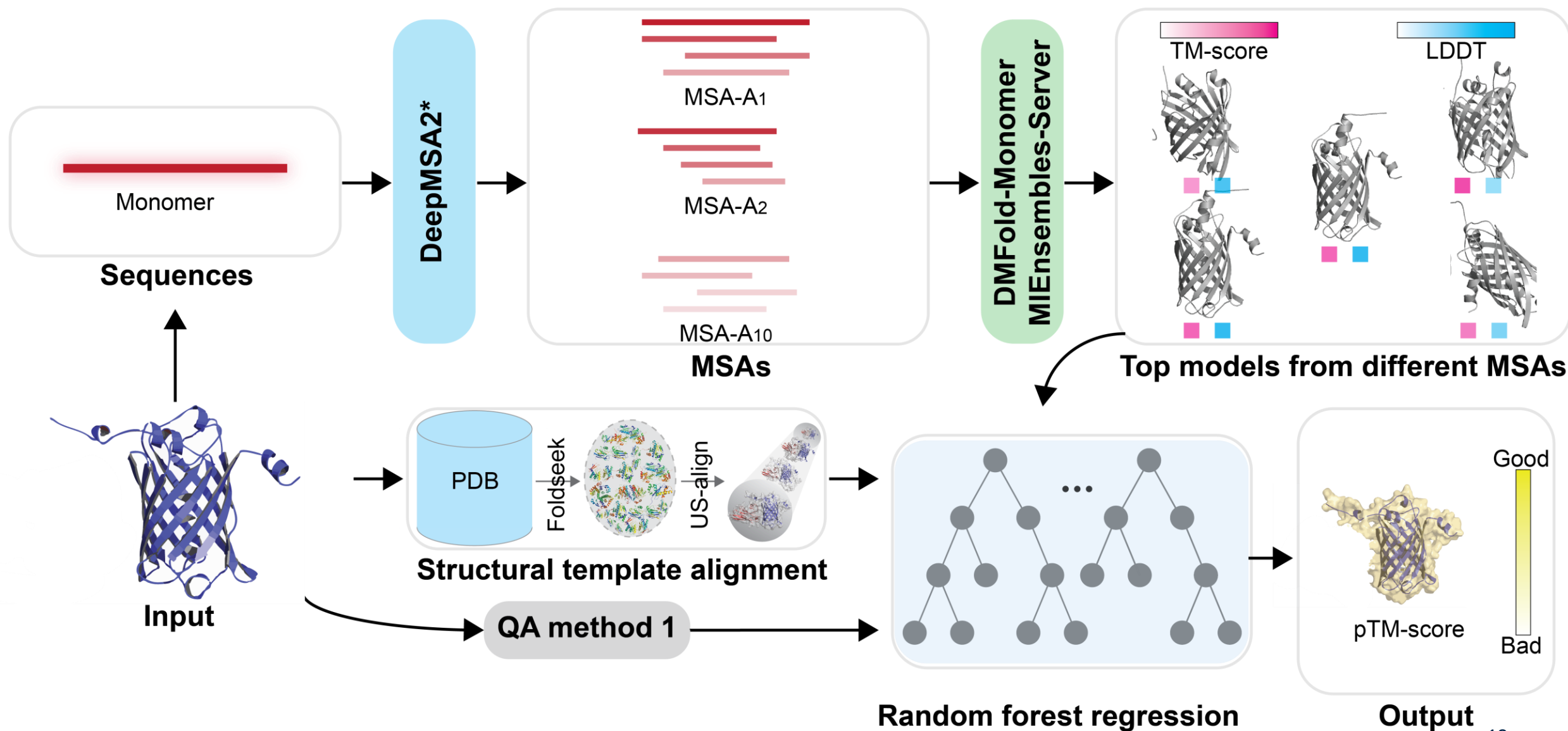
Top 5 DMFold model
TM-score: 0.375
DockQ: 0.014
LDDT: 0.730



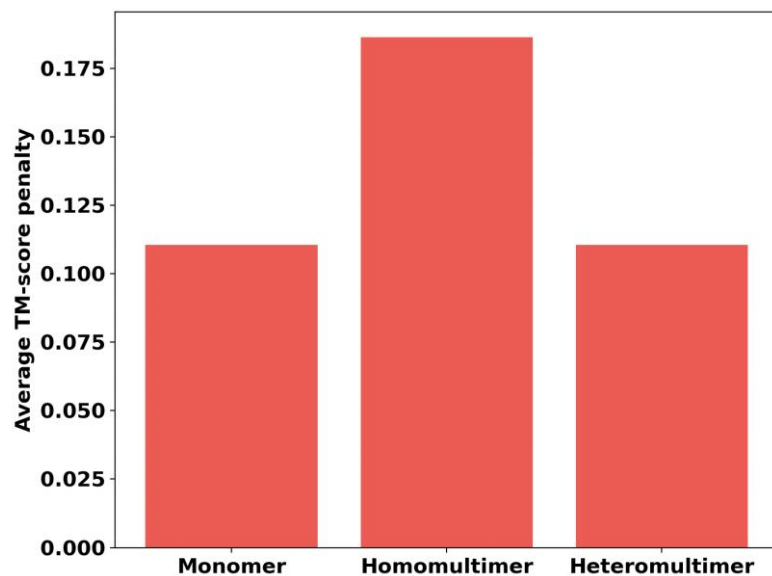
Good model among DMFold models
TM-score: 0.936
DockQ: 0.399
LDDT: 0.790



StrMQA for monomers



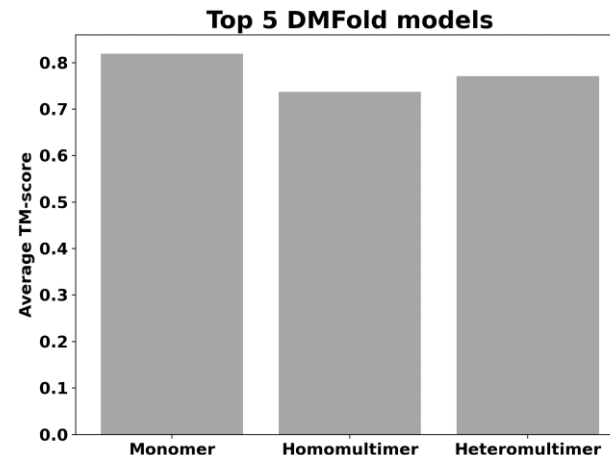
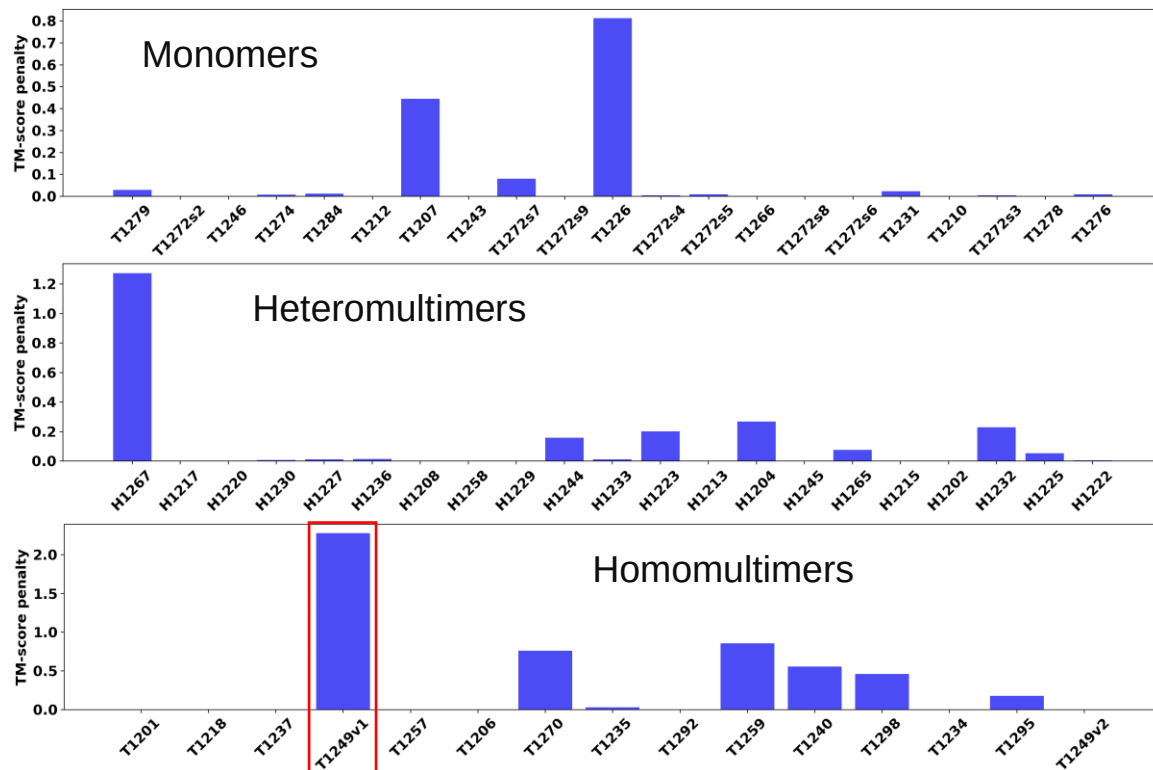
StrMQA results on MassiveFold decoys



TM-score penalty is calculated by taking the TM-score for each of the **5 models** chosen by the predictor and adding up the squares of the differences with the corresponding **top 5** scores found in the whole set of models.

Q: Do you have insights into why your method was most successful for monomers?

A: Compared to multimers, the StrMQA reference model have higher accuracy on monomers.



Conclusion

- ❑ StrMQA excels in scoring global structures and interfaces
- ❑ High-quality DMFold models serve as effective references
- ❑ Integrate diverse QA methods when reference models are lacking
- ❑ Expand reference conformations for greater robustness
- ❑ Extend StrMQA to provide per-residue interface reliability estimates

Acknowledgments

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Dr. Qiqige Wuyun
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Dr. Chunxiang Peng
Umich



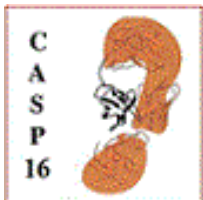
Quancheng Liu
Umich



Wentao Ni
NK



Ziyang Zhang
ZJUT



Umich: University of Michigan
NK: Nankai University
ZJUT: Zhejiang University of Technology
MSU: Michigan State University
SDFNU: Shandong First Medical University