Interdisciplinary Program of Biomedical Engineering, Assistive Technology, and Art and Sports Sciences, Faculty of Engineering, Niigata University
Tomohiko Hayashi Ph.D.

Computational study for designing peptide drugs based on statistical thermodynamics with sufficient accuracy and remarkably high speed

次世代ペプチド薬の物理理論に基づく高速デザイン法の開発

【Keywords】

Drug discovery and development	Peptide therapeutics	*In silico* screening	Free-energy calculation	High-speed computation

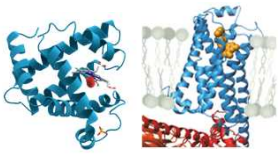
■ Summary

Computational strategies are widely used to design the peptide drugs with high affinity to the target proteins. **The rapid modeling of the native-like poses of a protein-peptide complex** is difficult but crucial.

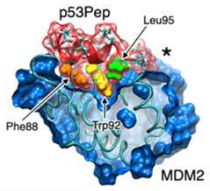
To overcome this issue, we have developed a physics-based free-energy function (FEF).[1,2] **For a protein-peptide complex possessing over 100 residues with a prescribed structure, the FEF calculation is finished in a few seconds on a standard workstation.**

Next generation therapeutics

Enzyme → Receptor



Protein-peptide interaction



A peptide with only 10 amino acid residues → More than 10 trillion candidates!

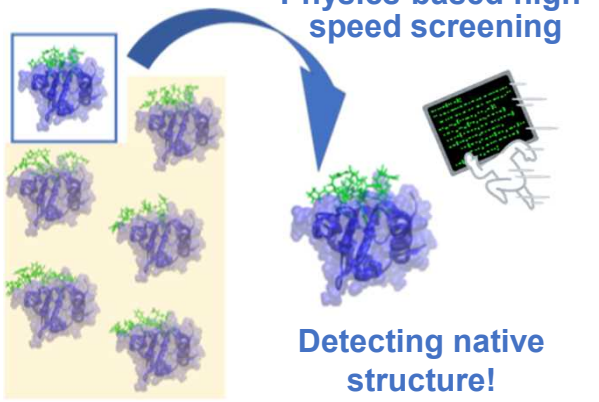
■ Subject Details/Topic

Our strategy is as follows:

(1) Complex structures with a wide variety of binding poses of a peptide are generated using the molecular dynamics simulation or the sampling algorithms employed in the protein-peptide docking programs

(2) FEF is applied to the structures

→ The protein-peptide complex giving the lowest value to FEF is identified



Advantages over competing study

Physical insights into the stability of a protein-peptide complex can be obtained clearly in a few seconds. The calculation time is comparable to the AI based methods.

Possible applications

- Designing and *in silico* screening of various drug candidates
- Development of nanobiotechnologies and nanodevices

(1) S. Hikiri, T. Hayashi et al., *J. Chem. Phys.,* 150:175101, 2019. (2) T. Yamada, T. Hayashi et al., *J. Chem. Inf. Model.,* 59:3533, 2019.

■ We hope to collaborate with…

Companies and research institutes related to pharmaceuticals, biotechnology, life sciences, health care equipment & services, and software & services

Contact us: **Niigata University, Institute for Social Innovation and Cooperation**
TEL:025-262-7554 FAX:025-262-7513 E-mail:onestop@adm.niigata-u.ac.jp