A pH replica exchange scheme coupled to the stochastic titration constant pH MD method

Diogo Vila-Vicosa¹, Chris Oostenbrink² and Miguel Machuqueiro¹

¹Centro de Química e Bioquímica, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal;
²Institute of Molecular Modeling and Simulation; University of Natural Resources and Life Sciences

email: diogo.vicosa@fc.ul.pt www: http://intheochem.fc.ul.pt/Members/diogovv.html

Goal

- Implement a pH replica exchange (pHRE) scheme within the stochastic titration constant-pH molecular dynamics (CpHMD) framework

Methods

- GROMACS 4.0.7 (MM/MD)
- GROMOS 54a7 force field
- DelPhi (Poisson - Boltzmann)
- PETIT (Monte Carlo)
- 2 pHRE freq. (20 and 100 ps)

\[ p = \min(1, e^{-\ln10(pH_2-pH_1)(N_1-N_2)}) \]

Ethylenediamine

Hen egg-white Lysozyme

- Titration curves and individual pKₐ values are very similar
- In a complex system, pHRE frequency do not show a significant effect

The titration curves are almost identical
- pHRE frequency has a small influence
- The effective number of exchanges must be carefully chosen
- In this small system, convergence speed is similar

Conclusions / Future Perspectives

- pH dependent conformational spaces are equivalent in both approaches
- The choice of pHRE frequency is determinant for the success of this approach
- The convergence of the titration curves is faster in pHRE schemes
- Can be applied to more challenging systems (water / membrane interface, for example)

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