AutoTS: An automated transition state search tool

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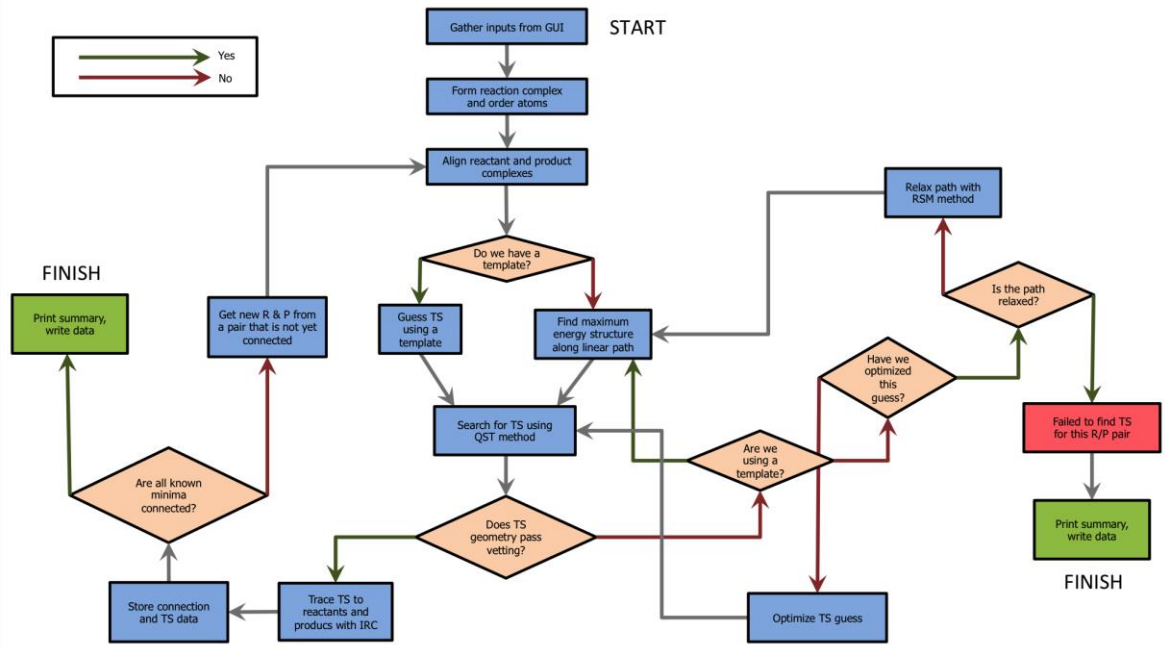
Transition state search is at the center of multiple types of computational chemical predictions related to mechanistic investigations, reactivity and regioselectivity predictions, and catalyst design. The process of finding transition states in practice is however a laborious multistep operation that requires significant user involvement.

We present a highly automated workflow designed to locate transition states for a given elementary reaction with a minimal setup overhead: The only essential inputs required from the user are the structures of the separated reactants and the products.

The workflow combines computational technologies from the fields of cheminformatics, molecular mechanics, and quantum chemistry. It automatically finds the most probable correspondence between the atoms in the reactants and the products, generates a transition state guess and launches the transition state search through a combined approach involving the relaxing string method and the quadratic synchronous transit. [1] Finally, it validates the transition state via the analysis of the reactive chemical bonds and imaginary vibrational frequencies as well as by the intrinsic reaction coordinate method. [2]

The approach is meant to be of general applicability for a wide variety of reaction types. It is highly flexible, permitting modifications such as a choice of accuracy, level of theory, basis set, or solvation treatment. Successfully located transition states can be used as templates for setting up transition state guesses in related reactions, saving computational time and increasing the probability of success.

The utility and performance of the method are demonstrated in applications to transition state searches in reactions typical for organic chemistry and medicinal chemistry.



[1]C. Peng, H. B.Schlegel, *Isr. J. Chem.* **1993**, *33*, 449-454.

[2]C. Gonzalez, H. B. Schlegel, *J. Chem. Phys.* **1989**, *90*, 2154-2161.