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The density gradient theory has been becoming a widely used framework for calculating surface tension, within which the same equation of state is used for the interface and bulk phases, because it is a theoretically sound, consistent and computationally affordable approach. Based on the observation that the optimal density path from the geometric mean density gradient theory passes the saddle point of the tangent plane distance to the bulk phases, we propose to estimate surface tension with an approximate density path profile that goes through this saddle point. The linear density gradient theory, which assumes linearly distributed densities between the two bulk phases, has also been investigated. Numerical problems do not occur with these density path profiles. These two approximation methods together with the full density gradient theory have been used to calculate the surface tension of various systems, from non-polar binary mixtures to complex multicomponent associating fluids, combined with the Peng-Robinson and the Cubic Plus Association equations of state. From an overall point of view, the approximation method with the density path profile passing the saddle point and the full density gradient theory offer comparable performance in predicting surface tension, while the linear density gradient theory frequently overpredicts. Limitations have been seen for all the three methods in correlating the surface tension of particular systems, with a single adjustable parameter for the cross influence parameter.

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