High Fidelity Thermocline Tracking Algorithm Using Weighted Essentially Non-Oscillatory Schemes

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High Fidelity Thermocline Tracking Algorithm Using Weighted Essentially Non-Oscillatory Schemes

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The Southwest USA has abundant solar energy resources in the country; hence developing new technology for solar energy harvesting becomes a natural choice for the scientists and engineers in the area. Our studies focus on a single tank Thermal Energy Storage (TES) for a Concentrating Solar Power (CSP) plant. Traditionally, two tank TES technology has been the most popular approach for thermal storage given that it allows for complete separation of hot and cold TES mediums, however this comes at a high cost both in space and monetary aspects. A single tank TES system provides an affordable alternative. A single tank TES utilizes thermocline concept to separate the hot and cold TES medium in a single tank. Comparison studies by the Sandia National Laboratories and National Renewable Energy Laboratory show that single tank storage can reduce the operational cost by 35%. One of the major challenges of achieving a one tank TES is to maintain the thermocline separation throughout the tank. To solve this, the different temperature fluids are introduced in a horizontal uniform manner rather than a jet stream method so that it does not become a homogeneous mixture. We assume that heat transport and diffusion occur only in the axial direction and that there are external heat sources or sinks present. The intent of the study is to improve the numerical algorithm for predicting the thermocline advection and diffusion using a high-order and combination of Weighted Essentially Non-Oscillatory (WENO) schemes. A high order scheme is expected to improve the predictability of the thermocline diffusion and advection processes, and hence provide a better estimate for non-useable form of energy in the tank.