Velocity profile in steady flow with submerged flexible vegetation

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Flexible submerged vegetation plays a pivotal role in ecosystem. Exploring the relationship between flexible vegetation deformation and flow velocity distribution is essential due to the complex disturbance caused by the bending characteristics of vegetation in water flow. Previous studies have typically relied on constant drag coefficients to predict vertical velocity distribution. However, the broad range of drag coefficient variability in flexible vegetation presents challenges in coefficient selection. In this paper, the developed prediction model of velocity profile based on multi-factor-dependent drag coefficient is derived by cantilever beam theory, dual-layer averaged velocity model and the relationship between the averaged inclination angle and Cauchy number, and the application of this prediction model is highly favorable. Meanwhile, a new analytical expression for depth-averaged drag coefficient of submerged vegetation with deformation angle and Reynolds number is proposed. These equations can reflect the influence of submergence as well. The findings of this study may provide valuable insights into the variability of drag coefficients and the flow structure with submerged flexible vegetation. And it can serve as a foundational basis for the restoration and management of freshwater ecosystems.