# ON THE CRITICAL KDV EQUATION WITH TIME-OSCILLATING NONLINEARITY

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ABSTRACT. For the initial value problem (IVP) associated the Korteweg-de Vries (KdV) equation with critical nonlinearity,

$$u_t + \partial_x^3 u + \partial_x(u^5) = 0,$$

it is known that, there is an initial data $\phi \in H^1(\mathbb{R})$ satisfying $\|\phi\|_{L^2(\mathbb{R})} > \|Q\|_{L^2(\mathbb{R})}$, where $Q$ is a solitary wave solution; such that the corresponding solution blows-up in finite time. With the evidence from numerical simulation, the physicists claim that a periodic time dependent term in factor of the nonlinearity would disturb the blow-up solution, either accelerating it or delaying it.

In this work we investigate the IVP associated to the equation

$$u_t + \partial_x^3 u + g(\omega t)\partial_x(u^5) = 0,$$

where $g$ is a periodic function. We prove that, for given initial data $\phi \in H^1(\mathbb{R})$, as $|\omega| \to \infty$, the solution $u_\omega$ converges to the solution $U$ of the initial value problem associated to

$$U_t + \partial_x^3 U + m(g)\partial_x(U^5) = 0,$$

with the same initial data, where $m(g)$ is the average of the periodic function $g$. Moreover, if the solution $U$ is global and satisfies $\|U\|_{L_x^5 L_t^{10}} < \infty$, then we prove that the solution $u_\omega$ is also global provided $|\omega|$ is sufficiently large.

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