

**PROCEEDINGS**

# A Fixed-Time Anti-Saturation Backstepping Guidance Law with Acceleration Constraints

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## ABSTRACT

A fixed-time anti-saturation backstepping guidance law (FTABGL) is designed for interceptor under acceleration input constraints. Firstly, an adaptive fixed-time anti-saturation compensator (AFAC) is proposed to ensure the stability of saturated system and drive it to faster leave the saturated region. Compared with conventional anti-saturation compensators, the auxiliary variable of AFAC is able to realize faster response speed and higher convergent precision when saturation disappears, which avoids the impact on convergent characteristics of original tracking error. In addition, the novel adaptive law in AFAC can further shorten the duration of saturation and improve the convergent speed of tracking error via adjusting gain in AFAC according to saturation of acceleration. Secondly, a recursive fixed setting time differentiator is utilized to approximate derivatives of virtual control signal exactly in fixed time, which avoids the complex computational burden residing in traditional backstepping control and improves convergent accuracy compared to command filtered backstepping control. Afterwards, a recursive fixed setting time observer is applied to estimate disturbance accurately in fixed time. With the estimated values compensated into controller, FTABGL can drive interceptor subject to acceleration constraints and external disturbances to realize higher guidance accuracy and effectively suppress the influence of acceleration saturation. Ultimately, simulations on interceptor are performed to verify the effectiveness and superiority of the methods proposed.

## KEYWORDS

Interceptor; anti-saturation compensator; fixed-time stability; backstepping guidance law; fast response speed; high convergent precision

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