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Modeling of Axial Rotary Drilling Dynamics as a Step Towards Drilling Automation

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Abstract

Analysis of low frequency axial drilling dynamics from block velocity input to surface weight on bit (SWOB) or differential pressure outputs, shows significant regional variation. This range in dynamics poses a robustness challenge for automated drilling control systems. Many factors influence drilling dynamics such as pipe stiffness, mud properties, tortuosity, friction, bit design, and BHA geometry. A simple analytic model representing axial drilling dynamics is described and compared to a finite element drilling model and to drilling data. The analytic model shows that axial drilling dynamics may be represented by a first-order transfer function with a time constant dependent on axial stiffness and drillability.

