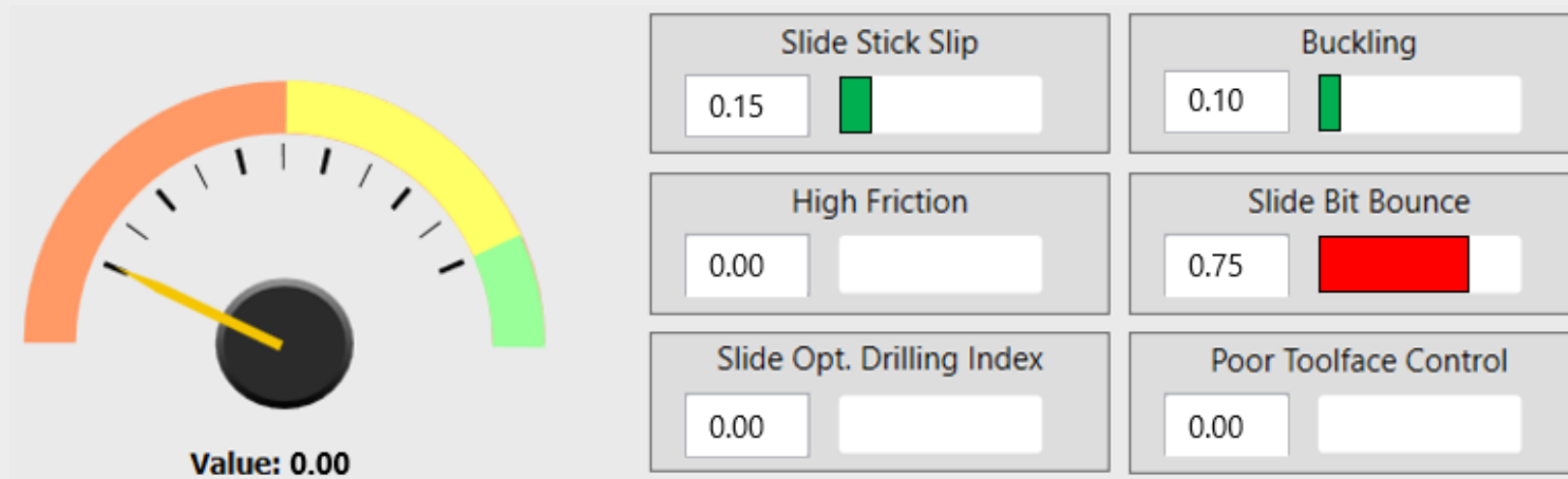


Slide Optimal Drilling Index

Index ranging from 0 to 1 denotes the presence/absence of slide drilling dysfunctions



Optimal drilling index low during dysfunction

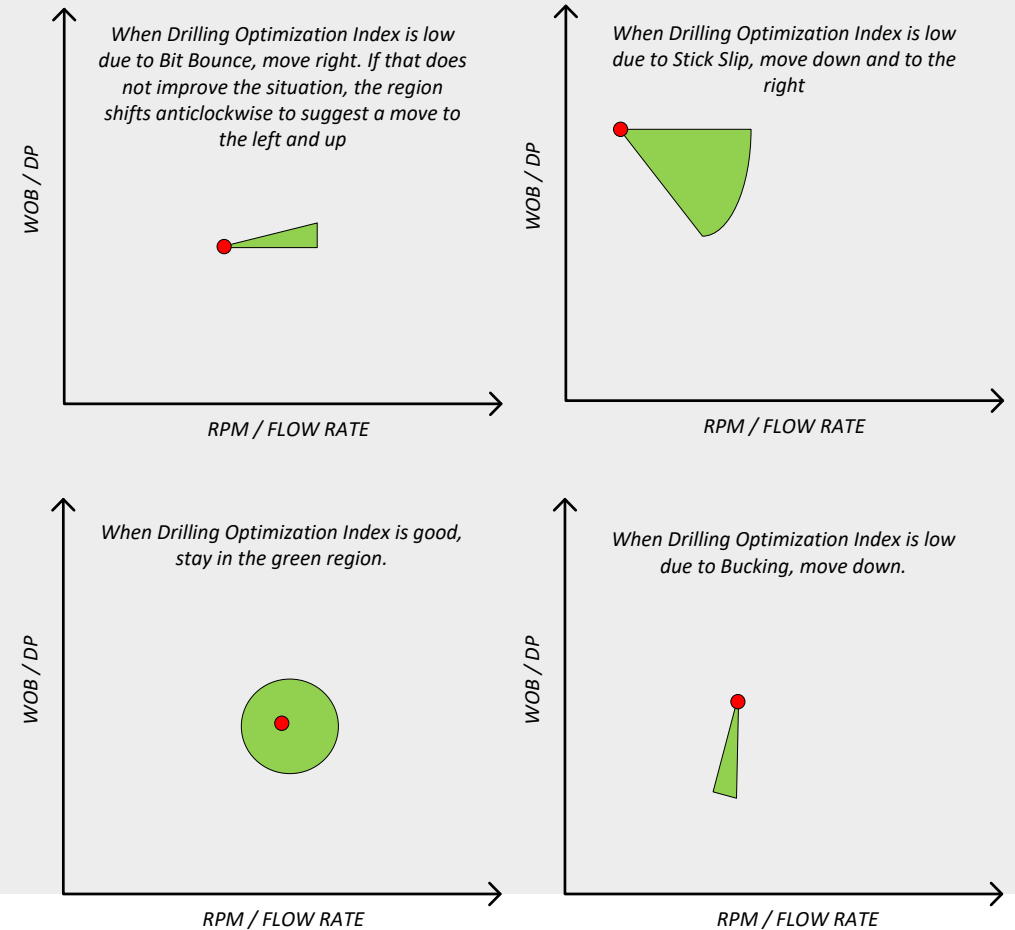
Dysfunction Mitigation

Dysfunction	Suggested Corrective Action
Stick Slip/Motor Stall	Increase flow rate, decrease differential pressure
Bit Bounce	Increase flow rate, then increase differential pressure if issue persists
Buckling	Decrease differential pressure
High Friction	Consider pipe rocking regime
Poor Toolface Control	No suggested action for poor toolface control as maintaining toolface is best handled by the directional driller accounting for local factors such as the formation being drilled. However, check if excessive pipe rocking could be a cause.

Cone Drilling

- Advisory system: suggests WOB, differential pressure adjustments when following dysfunctions are present
 - Stick slip / motor stall, bit bounce, buckling
- Cone points in the direction of suggested adjustments
- User may choose to incorporate other conditions to Cone behavior that take precedence over default cone behavior
 - e.g., Never suggest differential pressure adjustments above operator defined limits

The red dot represents the current operational point and green represents the suggested operational region

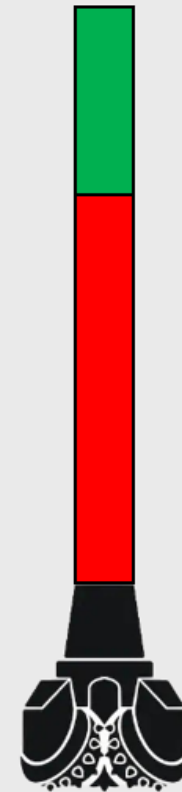


Example Cone behavior during dysfunction

Pipe Rocking Friction: Pipe Rock Percentage

- Modeled percentage of drill string in dynamic friction
 - Modeled using pipe rocking period and RPM
- Pipe rocking model estimates effective friction at current RPM and period
- Uses well path, well geometry to calculate friction factors, normal forces, damping factor, etc.

Pipe Rock Percentage

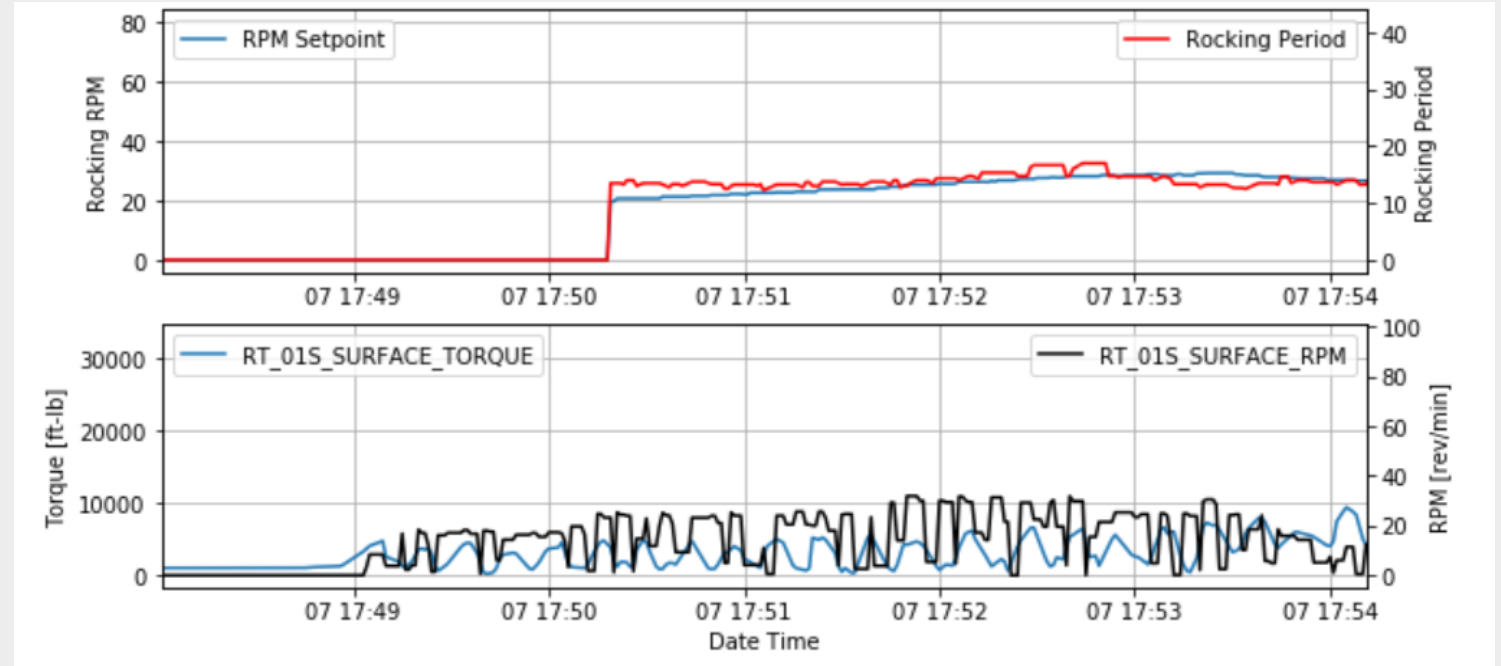


30 % Pipe Rock

Regions of dynamic and static friction during pipe rocking

Pipe Rocking Friction: Pipe Rock Period

Period can be determined for both torque-based pipe rocking and RPM-based pipe rocking using peak detection



Pipe Rocking Friction: Pipe Rock RPM

- The estimated RPM of pipe rocking.
- Calculated by taking the average RPM at the peaks of the signals over a short time window

