

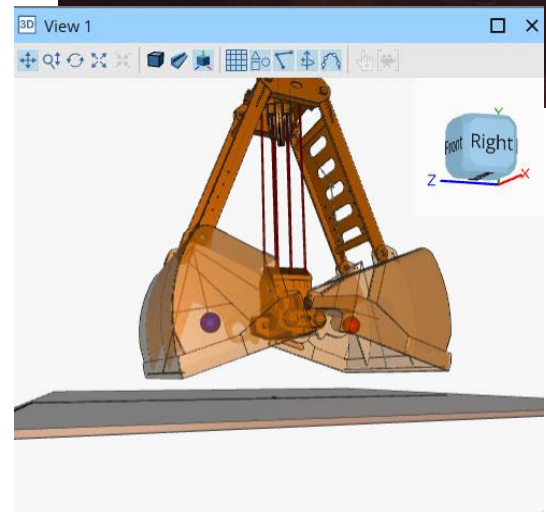
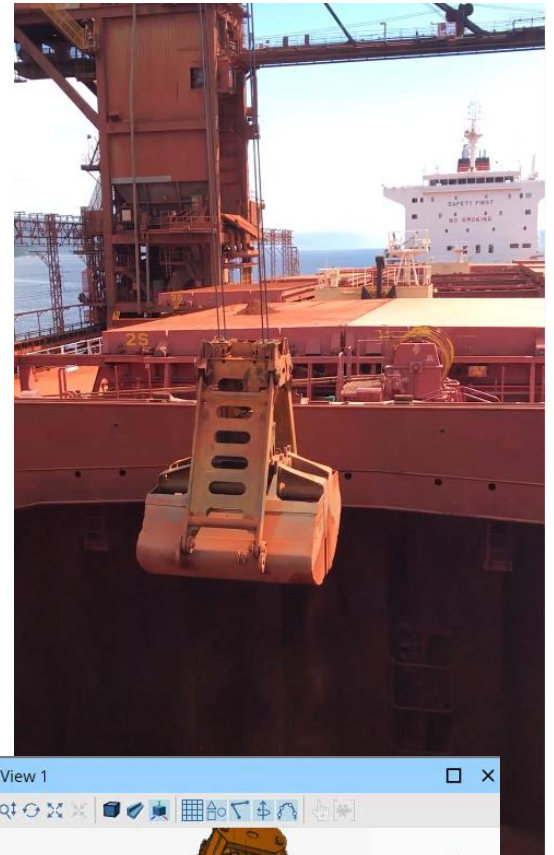
Grab bucket (clamshell) unloaders are the workhorses of the material handling industry and are used for unloading many materials including coal, grain, lime, sugar, and more. Capable of moving multiple tons of material in a single grab, it is no wonder why grab buckets are relied on heavily. However, many of these giants have been in service for several decades with the original or the nearly original control systems in place. With antiquated control system components such as drives, load-share boards (black box), PLCs, or motors, one failure can mean devastating and costly down-time.

At Prokuma, we have successfully upgraded many grab bucket unloaders and their supporting equipment's control systems including:

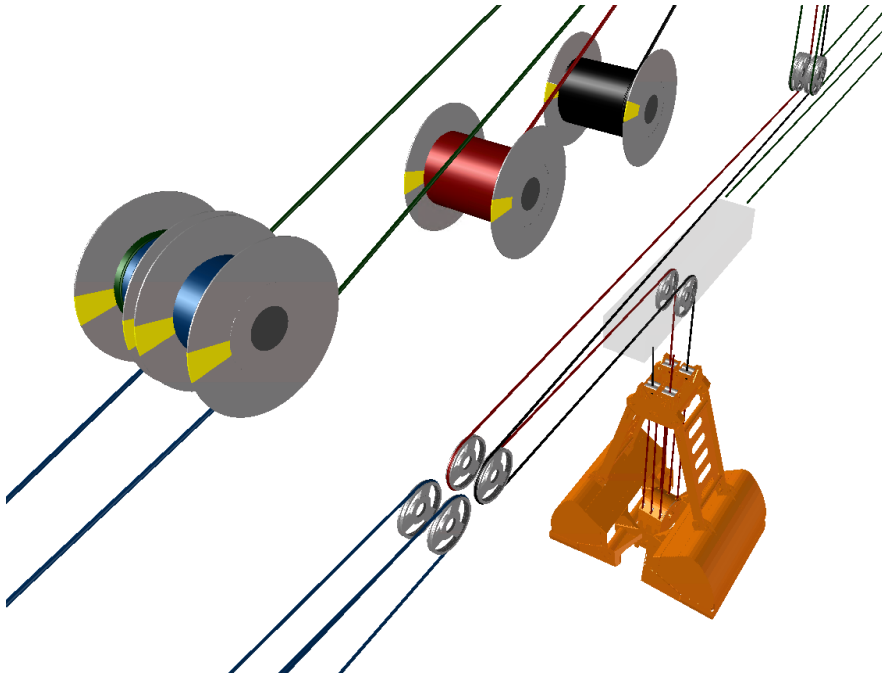
- Hold and close AC & DC drives
- Unbalanced load sharing
- Electrical enclosure builds and rebuilds
- Programmable encoder-based limits for easy cable replacement
- Trolley drives with anti-swing technology
- Barge hauls with tension control
- Translation control and auto-positioning
- Automatic unloading take-over
- Safety design
- IP cameras for monitoring conveyors and motor rooms
- PLC based control systems
- PLC-free control systems
- Operator chairs and joy sticks with dig mode
- Flat-Close bucket mode
- Slack prevention/Over-opening prevention
- Material Contact Stop
- Loadcell-less Weight determination
- Fast Hoist/Automatic cable tightening
- One-Touch Open & Close
- Collision prediction and prevention
- Operator interface screens; operator & grab profiles
- Tonnage reporting
- Localization for easy troubleshooting in your language

Successful systems include the following drives:

- Allen-Bradley [PowerFlex DC, PowerFlex 755](#)
- Siemens [Sinamics DCM](#)
- ABB [DCS800, DCS880, ACS880](#)



Digital Twin System Model



Our digital twin grab bucket unloader models allow us to simulate and test our features to meet and exceed project requirements. With all real-world system dynamics accounted for within the model, we build robust algorithms that combat nature and man-made disruptions including:

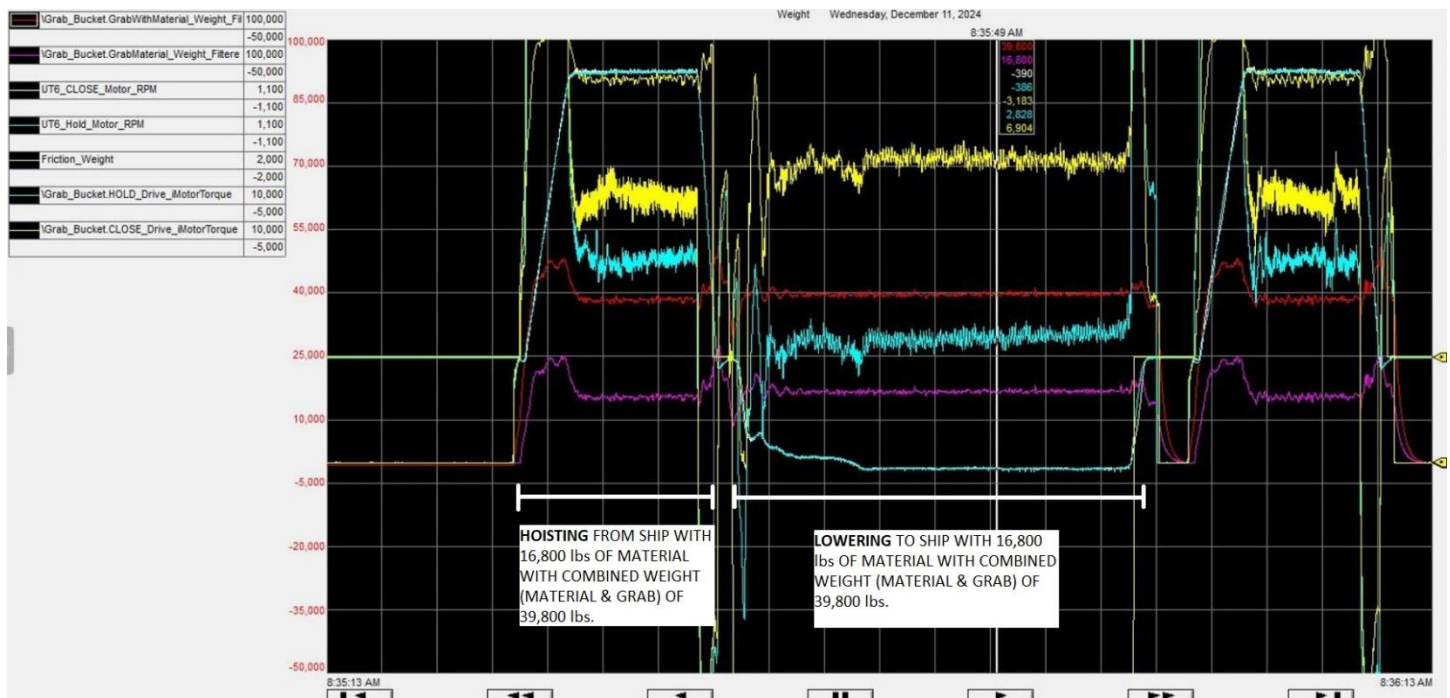
- Wind
- Gravity
- Sway
- Acceleration/Deceleration
- Friction
- Motor and drive train limits
- Cable and grab masses and shifting
- Static and dynamic inertias

We have models for multiple different unloader wire rope types and cable configurations.

Load Calculation

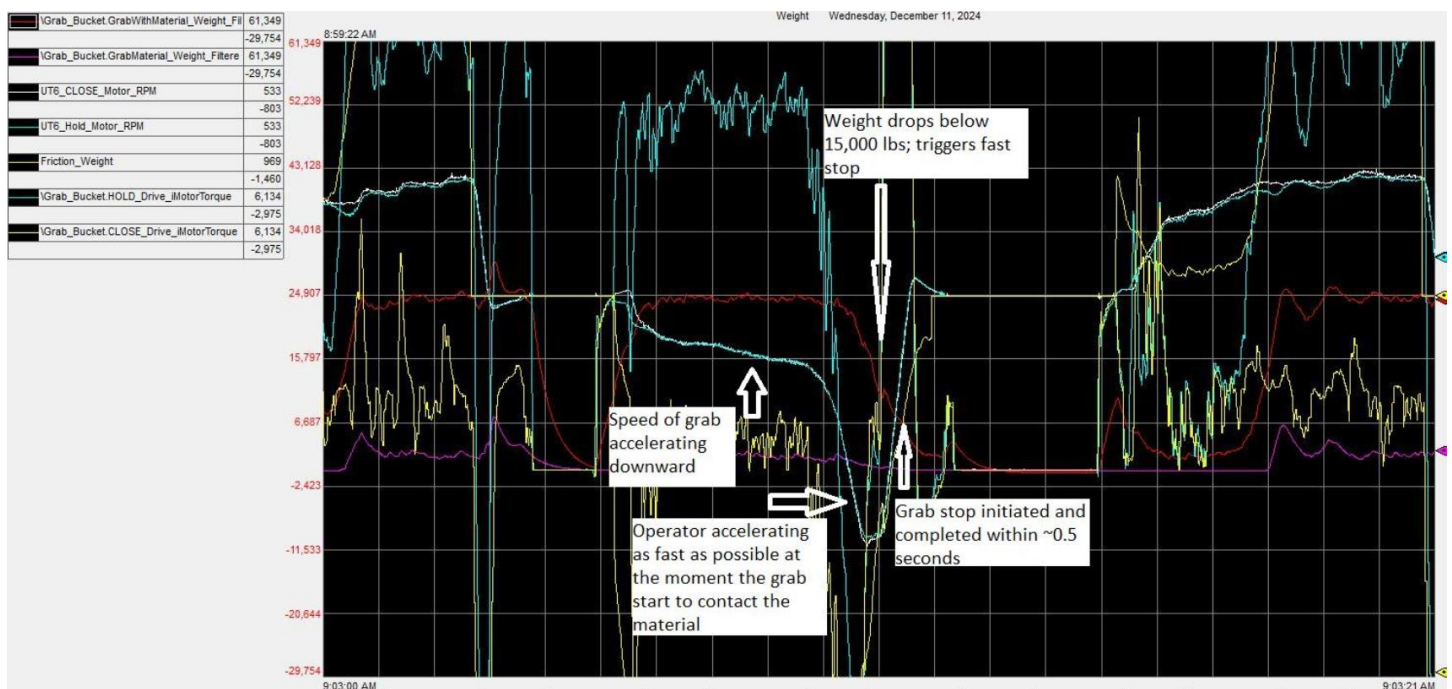
There are many benefits in knowing the weight of the load. The grab bucket unloader components include functions for calculating the weight of the objects within the system including:

- Suspended cable for individual winches
- Grab bucket
- Material within grab bucket
- Auto-calculation of system inertias including spare cable variations



Contact Stop

When upgrading to fully autonomous unloading, simply training a new operator, or piece of mind for temporary lapse in concentration, our grab bucket unloading package can include the optional Contact Stop feature. This feature incorporates back-differencing, predictive stopping distances using various acceleration curves, and load calculations to stop the grab as it contacts the material in the ship or barge. Our grab controller system can detect contact with material from any height above the material while accelerating, decelerating, or traveling at a constant downward speed. The trend below illustrates an operator attempting to create the most difficult scenario for detecting the grab's contact with material which is full downward acceleration at the moment of contact with the material. Our grab controller is still able to detect contact and stop the grab within 0.5 seconds. So quickly, in fact, some operators request the stop to pay out extra cable.



Fast Hoist

To conserve cable life and limit stress on the trolley and boom, our Fast Hoist option will close the grab quickly and exactly prior to hoisting the grab to the tower hopper. This also improves load share performance and load calculation performance.

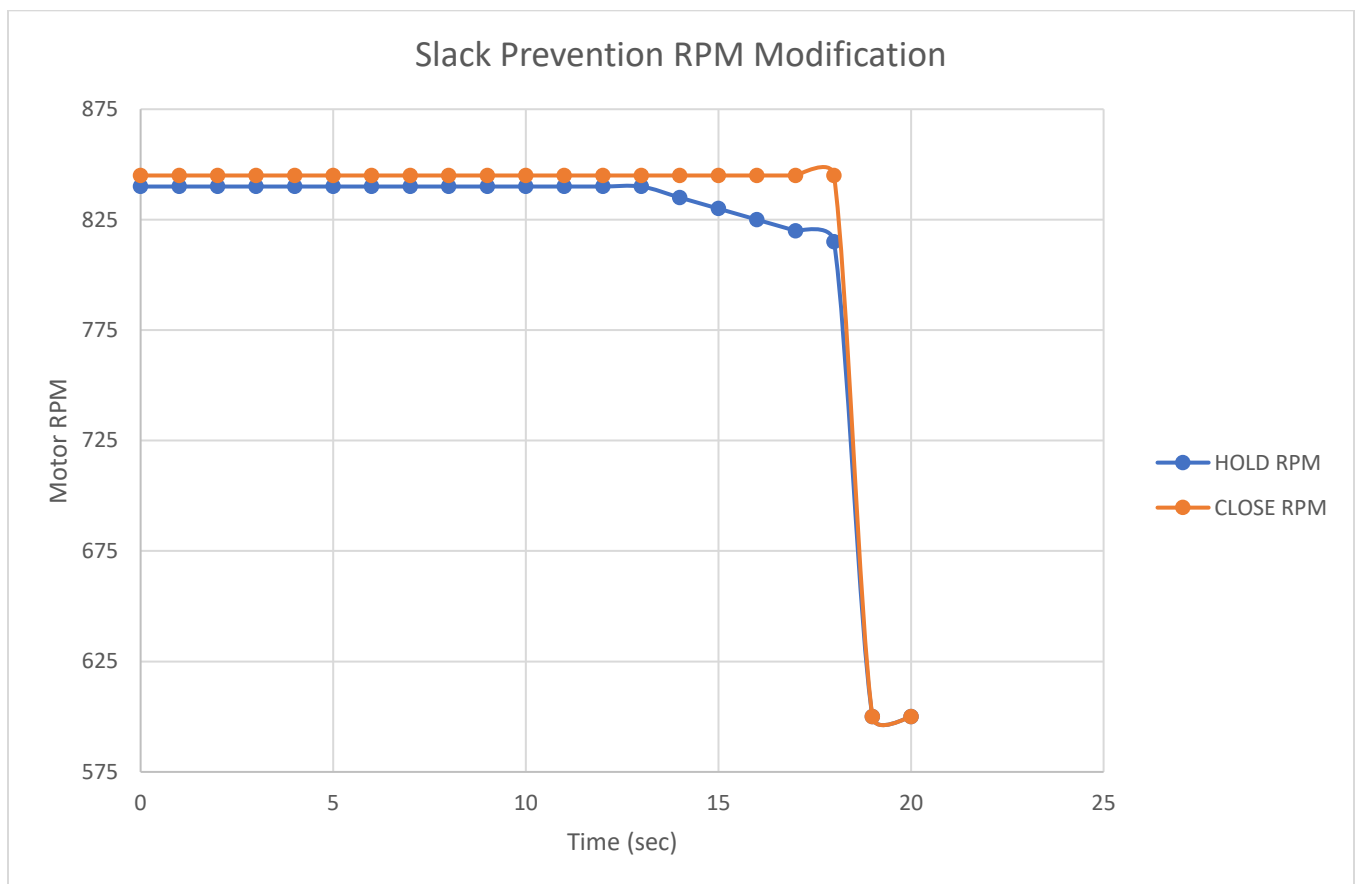
Call for a quote: 1 812-461-1681 (1 812-568-1746) or email questions to sales@prokuma.com

Slack Prevention

Slack in the hold and close cables marginally increases unloading time every time the operator must recover the slack prior to resuming unloading. This can lead to many hours of additional unloading time. Our slack prevention algorithms allow for full unloading capabilities without compromising speed. The following actions are typically responsible for the introduction of slack in one of the cables.

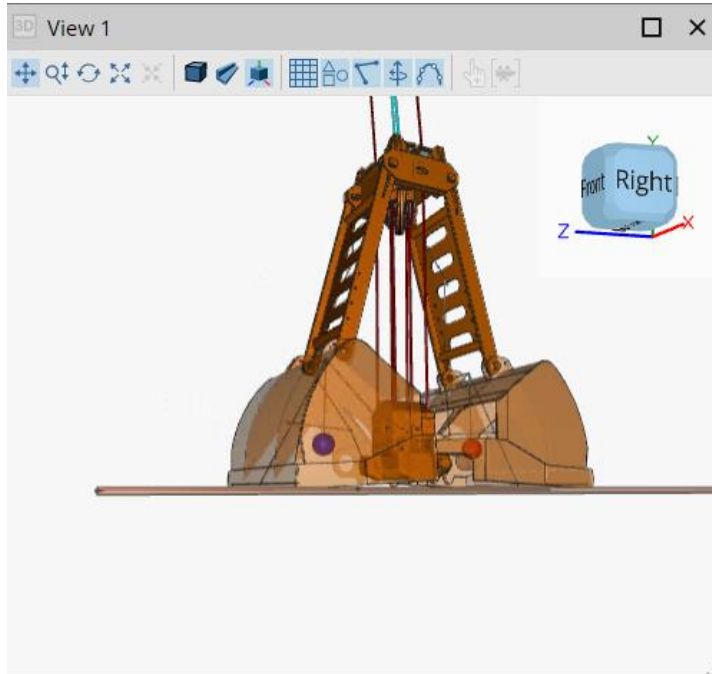
Dumping
Descending while opening or closing
Closing
Digging

Our slack prevention algorithms predict when the hold or close cable will become slack at any operating speed and the respective motor is disallowed to continue motion in the direction that produces slack under any given circumstance. This allows the operators to plan the next action instead of figuring out how to complete the previous.



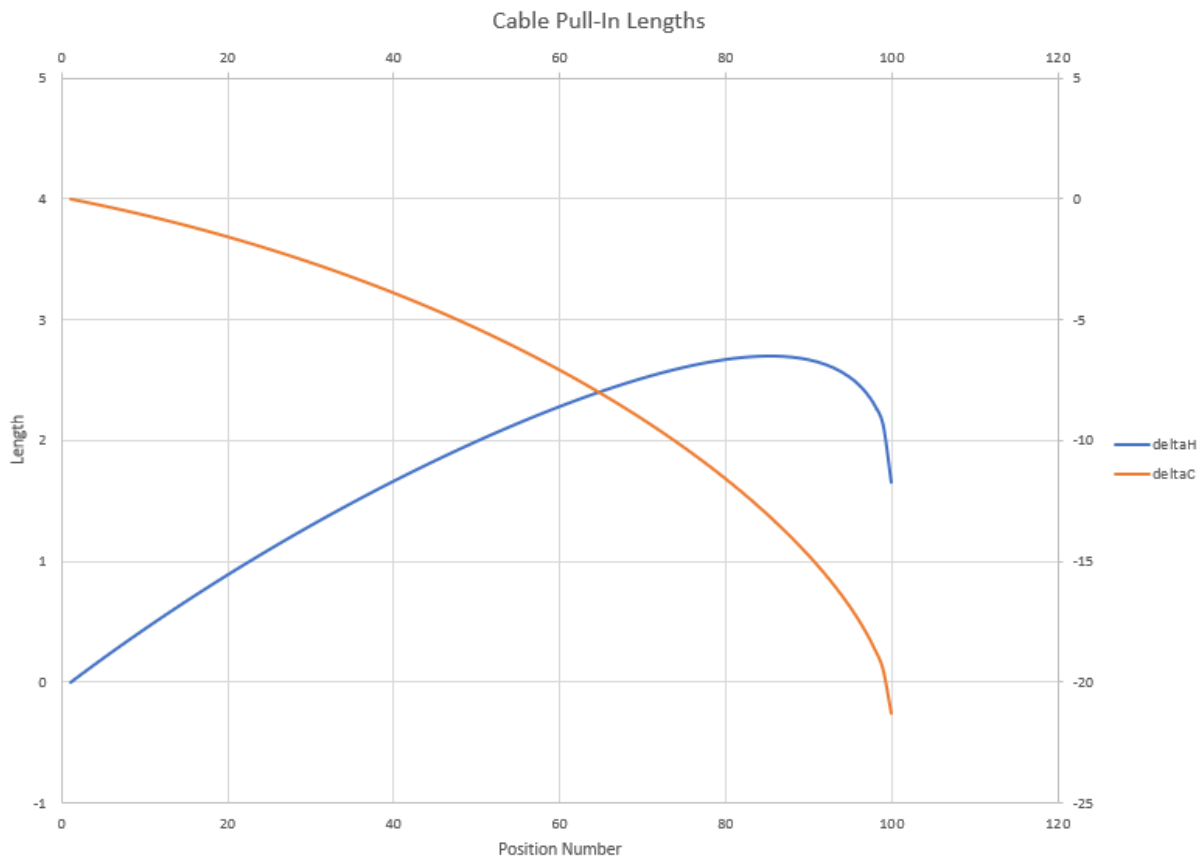
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Flat-Close

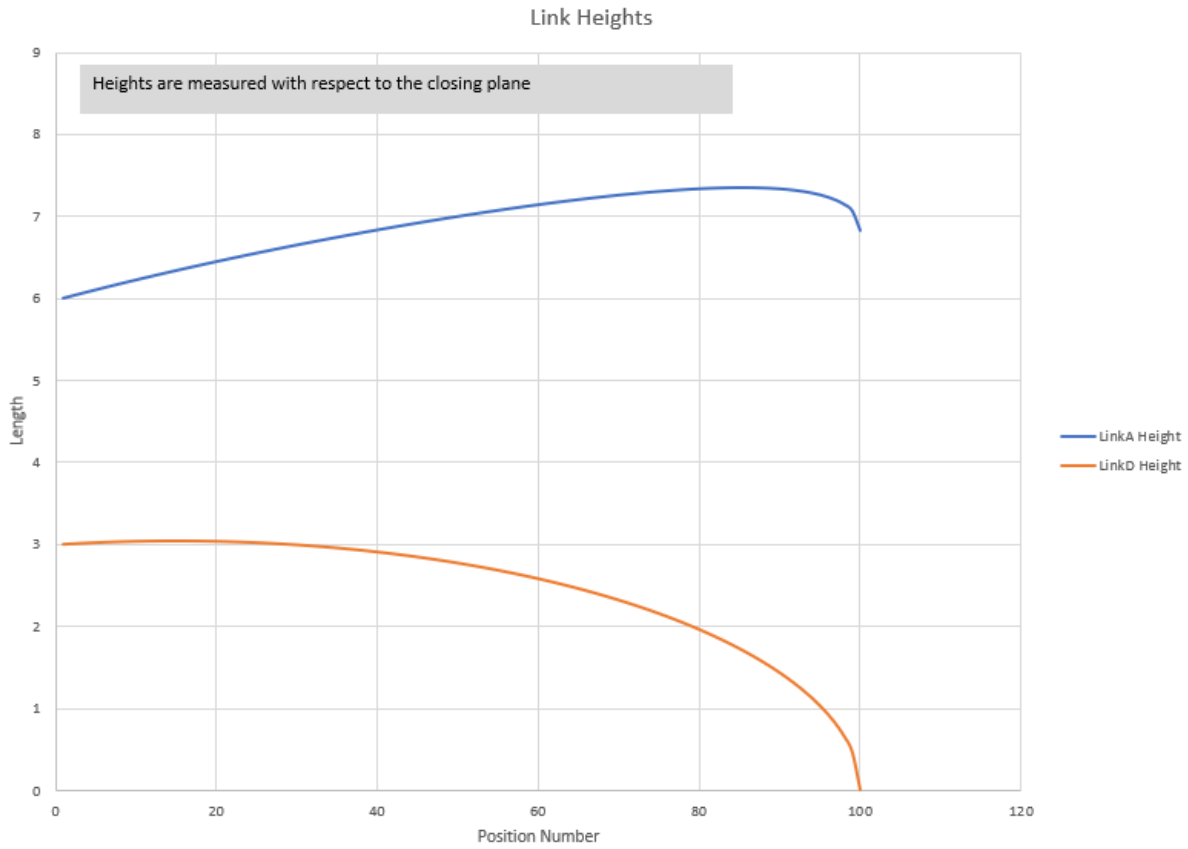


Our complete understanding of the physical characteristics of grab buckets gives Prokuma the advantage and ability to deliver a superior control system. Our proprietary, parameterized analysis tools allow us to make control decisions based on exactly where the grab bucket is in relation to any defined point in the system. This allows our grab bucket control system to avoid unnecessary transfer of weight to the hull of a ship or barge and eliminate collisions with equipment.

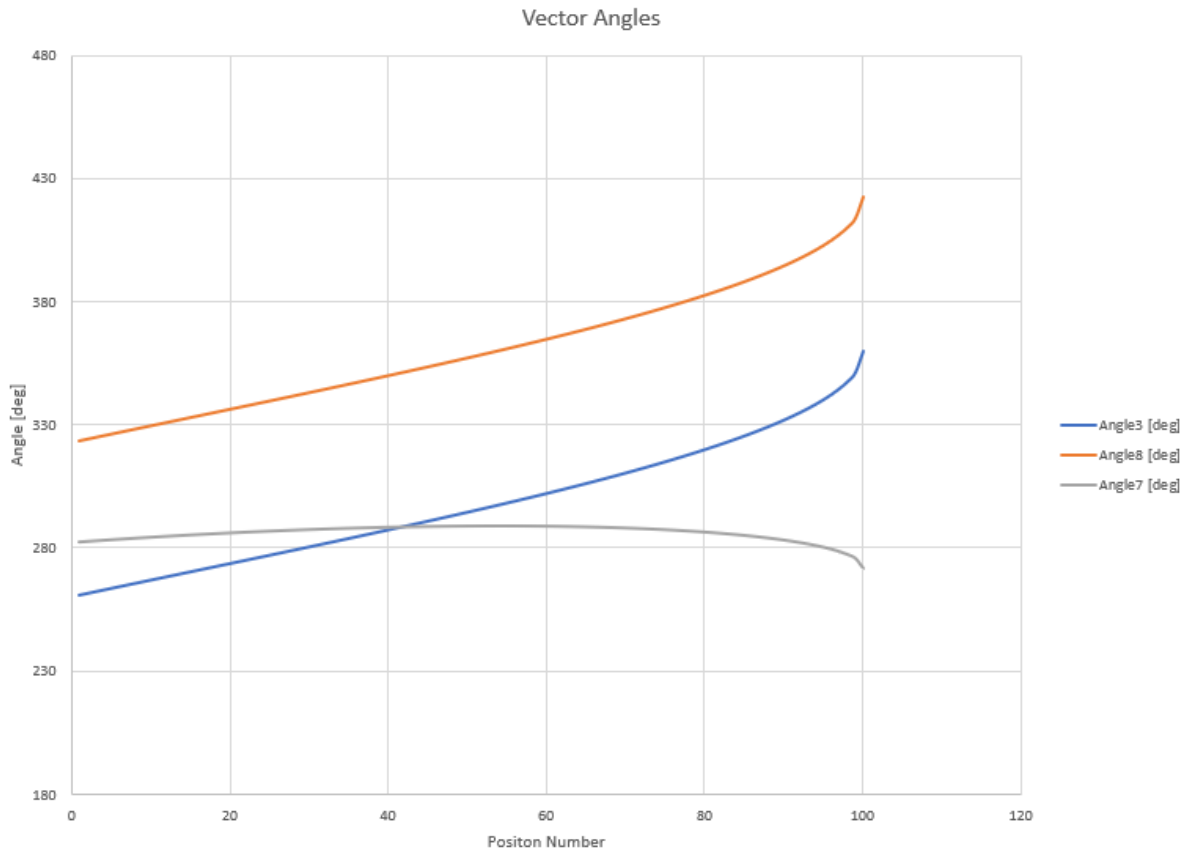
The grab bucket jaws will travel exactly horizontally while closing by manipulating both the hold and close cables as required by the mechanical design of the grab bucket. This move is the balance between a pure closing motion and a dig motion.



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