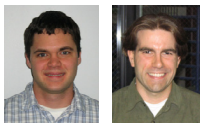
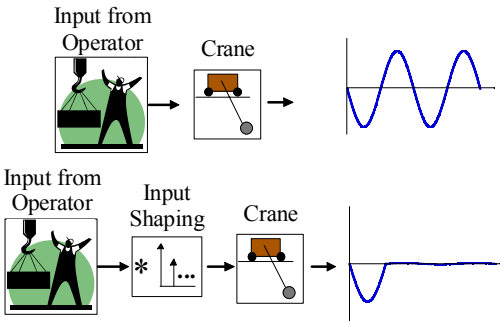
Input Shaping with Common Nonlinearities

Jon Danielson and Jason Lawrence
George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology



INPUT SHAPING

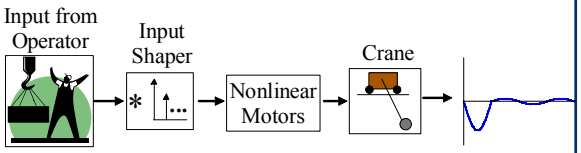
Payload swing of cranes is detrimental to efficiency and safety of operation. Input Shaping is used to reduce swing:



NONLINEAR MOTORS

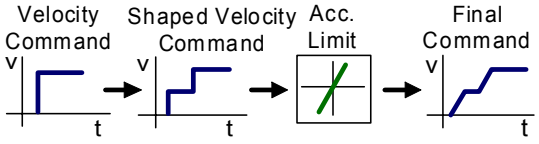
Portable Bridge Crane

Nonlinear motors cause input shaping to work poorly.

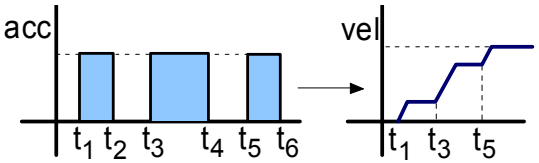


LIMITED ACCELERATION

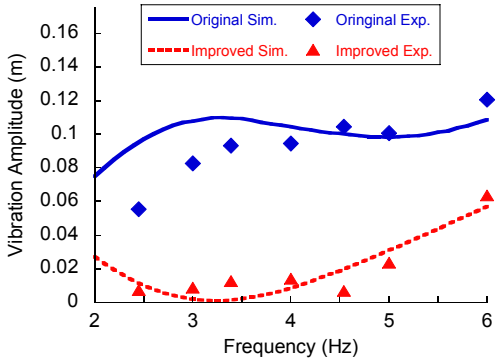
Problem: Real systems cannot accelerate to full speed instantaneously:



Solution: Design Input Shaper that compensate for acceleration limit

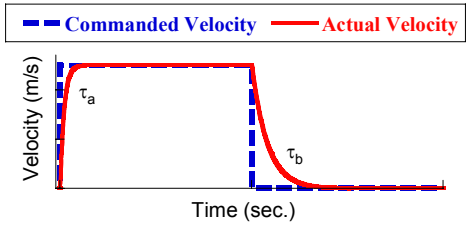


Result: Better performance:



NONSYMMETRICAL BRAKING

Problem: System accelerates at a different rate than which it brakes.



Solution: Design shapers that compensate for this non-symmetry.

Method:

1. Perform linear systems analysis to derive input shaper.
2. Perform numerical optimization to derive an input shaped command.

Result: Better performance: