

## Mathematical Formulation

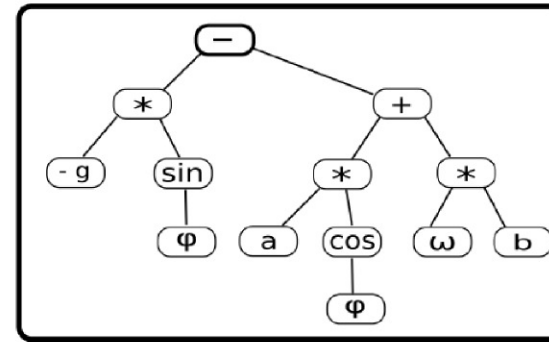
$$\begin{aligned} \min_{x,u} \quad & \int_0^T x^2 + u^2 dt \\ \text{s.t.} \quad & \dot{x} = f(x, u) \\ & x(0) = x_0 \\ & -1 \leq u \leq 1. \end{aligned}$$

## ACADO Syntax

```
DifferentialState    x;  
Control             u;  
  
DifferentialEquation f;  
f << dot(x) == u + ...;  
  
ocp.minLagrangeTerm( x*x+u*u );  
ocp.subjectTo( f );  
ocp.subjectTo( -1 <= u <= 1 );
```



## Symbolic Structure Detection



## Algorithm

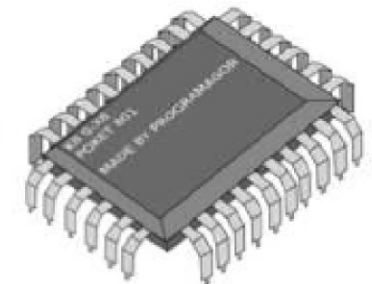
- Multiple Shooting
- Real-Time Gauss Newton
- Online Active Set Strategy

## Optimized C-Code

```
r[1] = a[15]*c[17] + a[16]*c[19] + ... ;  
r[2] = sin(a[1]*a[2]) + a[4] + ... ;  
r[3] = cos(r[1])/exp(c[4])+ r[1] +... ;
```

## Customized Solver Implemented on Chip/FPGA:

Measurement  $x_0$



Optimal Decision  $u^*$