

# Os benefícios de uma arquitetura completamente reconfigurável para controle de movimento

Nome do apresentador

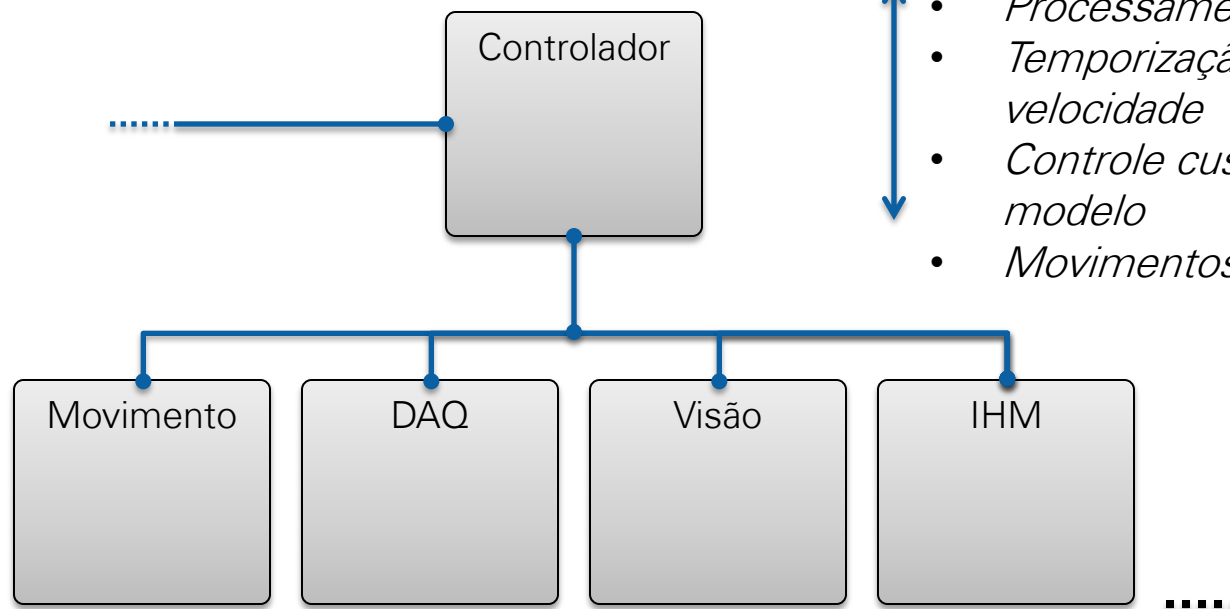
Cargo

# Tópicos

- Máquinas de alto desempenho devem *integrar firmemente* o controle de movimento com subsistemas *especializados*, para realizar tarefas complexas.
- Essas tarefas são difíceis ou impossíveis para se utilizar as abordagens tradicionais.
- A arquitetura LabVIEW RIO fornece um novo caminho para cumprir essas tarefas.
- Exemplos
- Resumo

# Controle avançado de máquinas

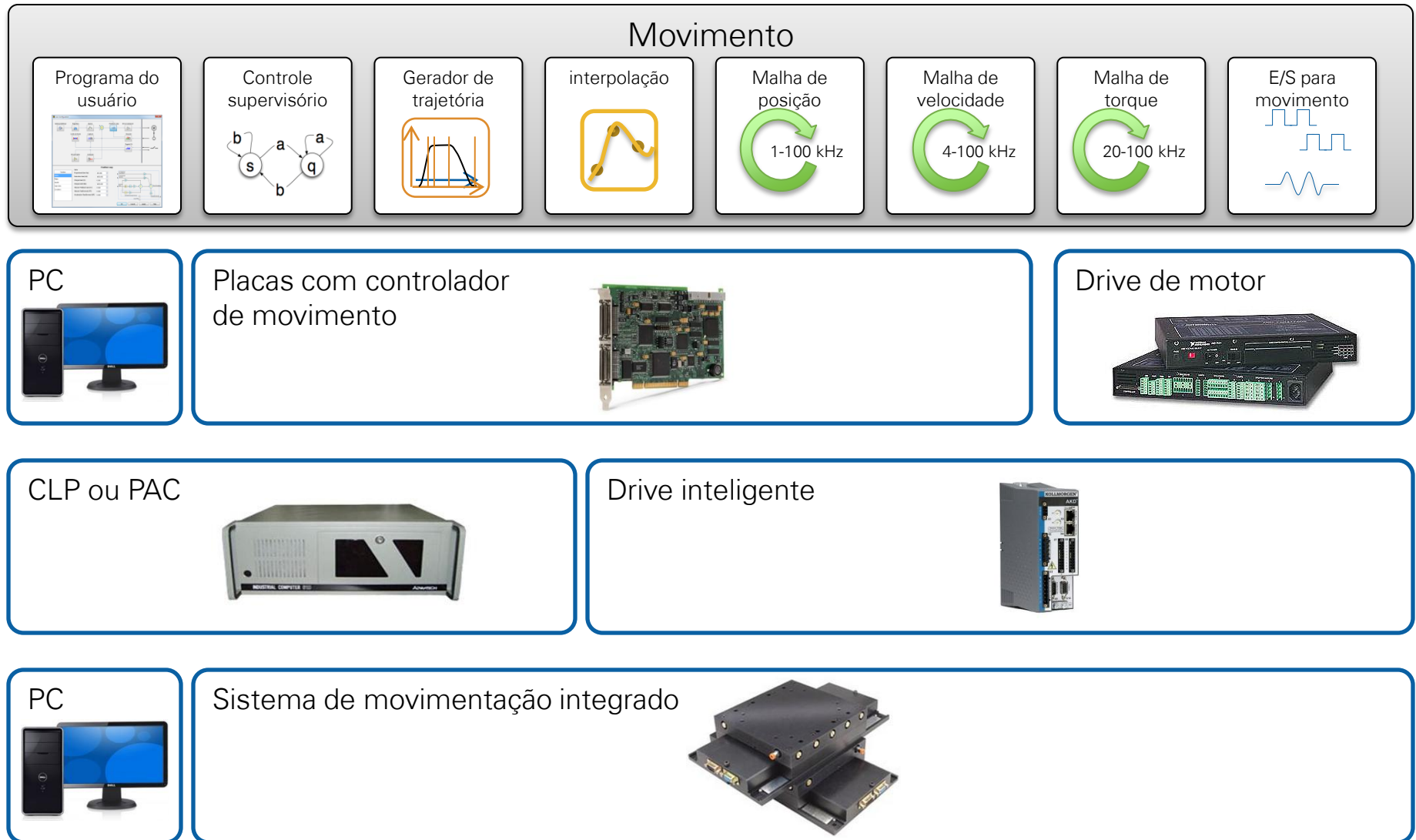
- O que realmente torna uma máquina inteligente é a habilidade de *integrar firmemente* múltiplos subsistemas *especializados*, a fim de atender às exigências da máquina.



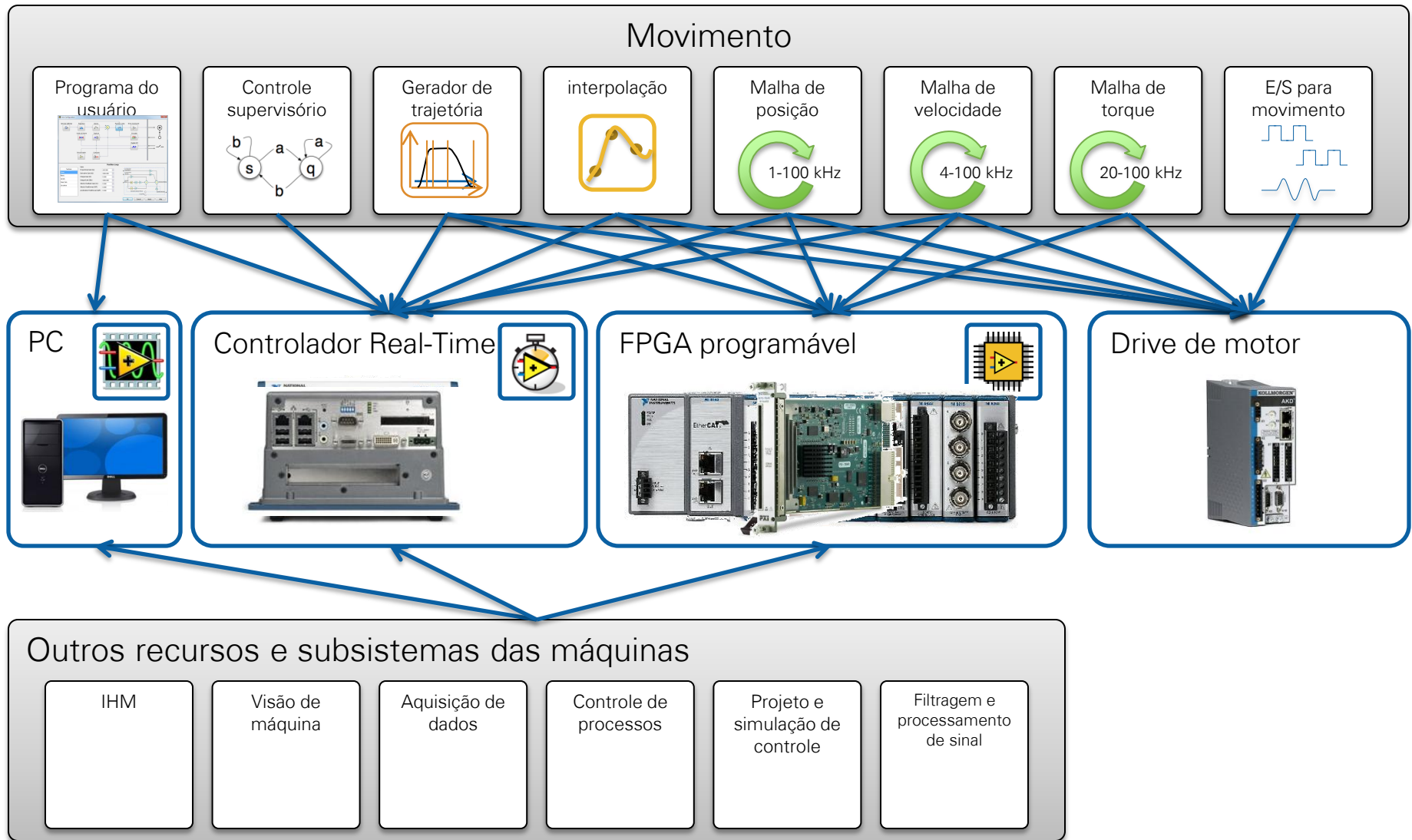
Integração do controle de movimento

- *Medições em alta frequência*
- *Processamento e filtragem de sinal*
- *Temporização e trigger de alta velocidade*
- *Controle customizado ou baseado no modelo*
- *Movimentos multieixo coordenado*

# Arquiteturas tradicionais do sistema de movimento

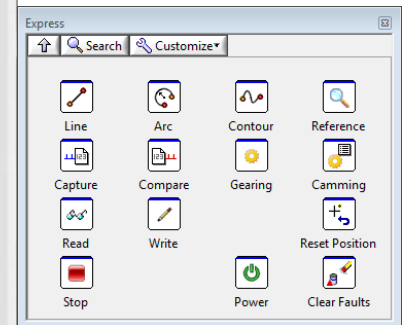
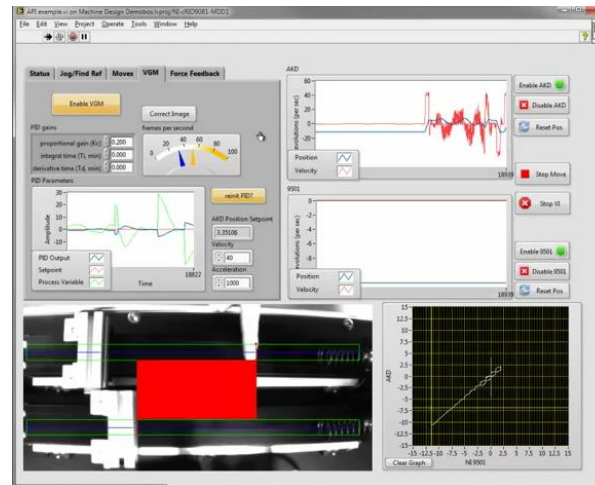
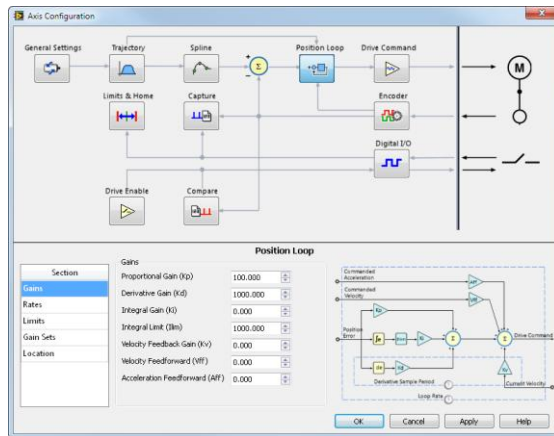


# Arquitetura completamente reconfigurável para controle de movimento



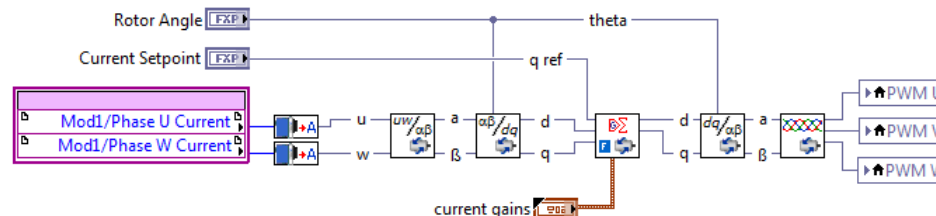
# NI SoftMotion

- Uma abordagem aberta e modular para projetar aplicações de controle de movimento com a arquitetura LabVIEW RIO

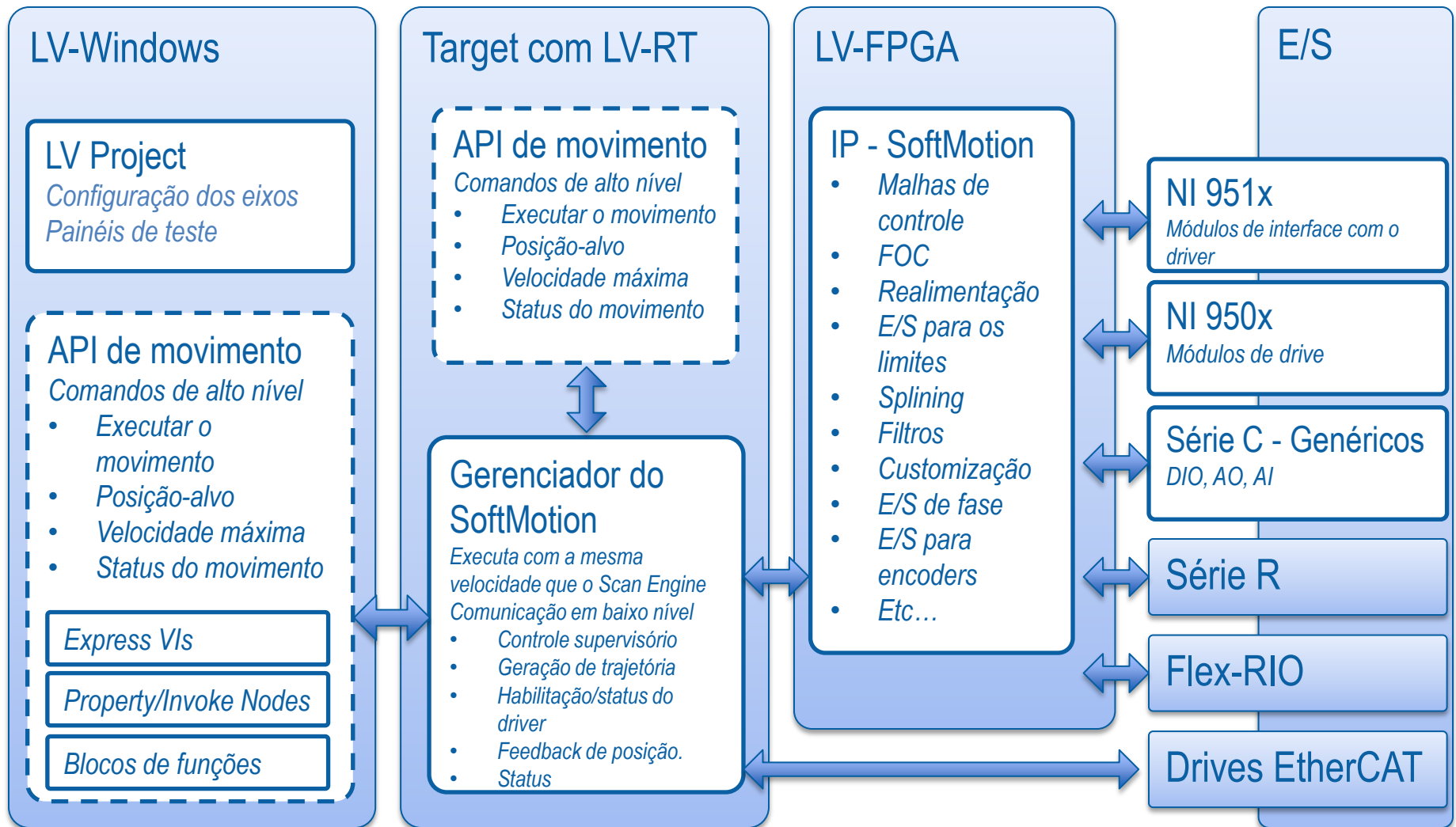


Configuração e Setup a partir da janela do LabVIEW Project

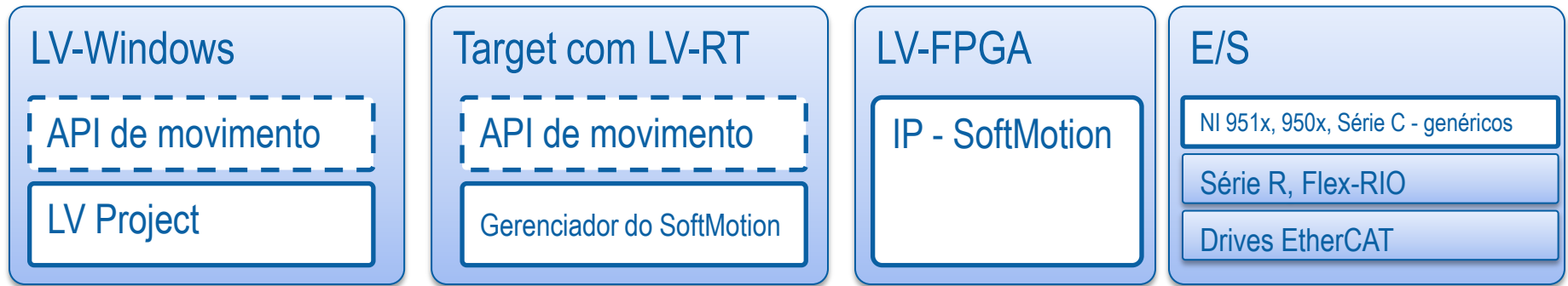
APIs de alto nível para Windows e LabVIEW Real-time



# Arquitetura do NI SoftMotion



# Arquitetura do NI SoftMotion



## Flexibilidade de software

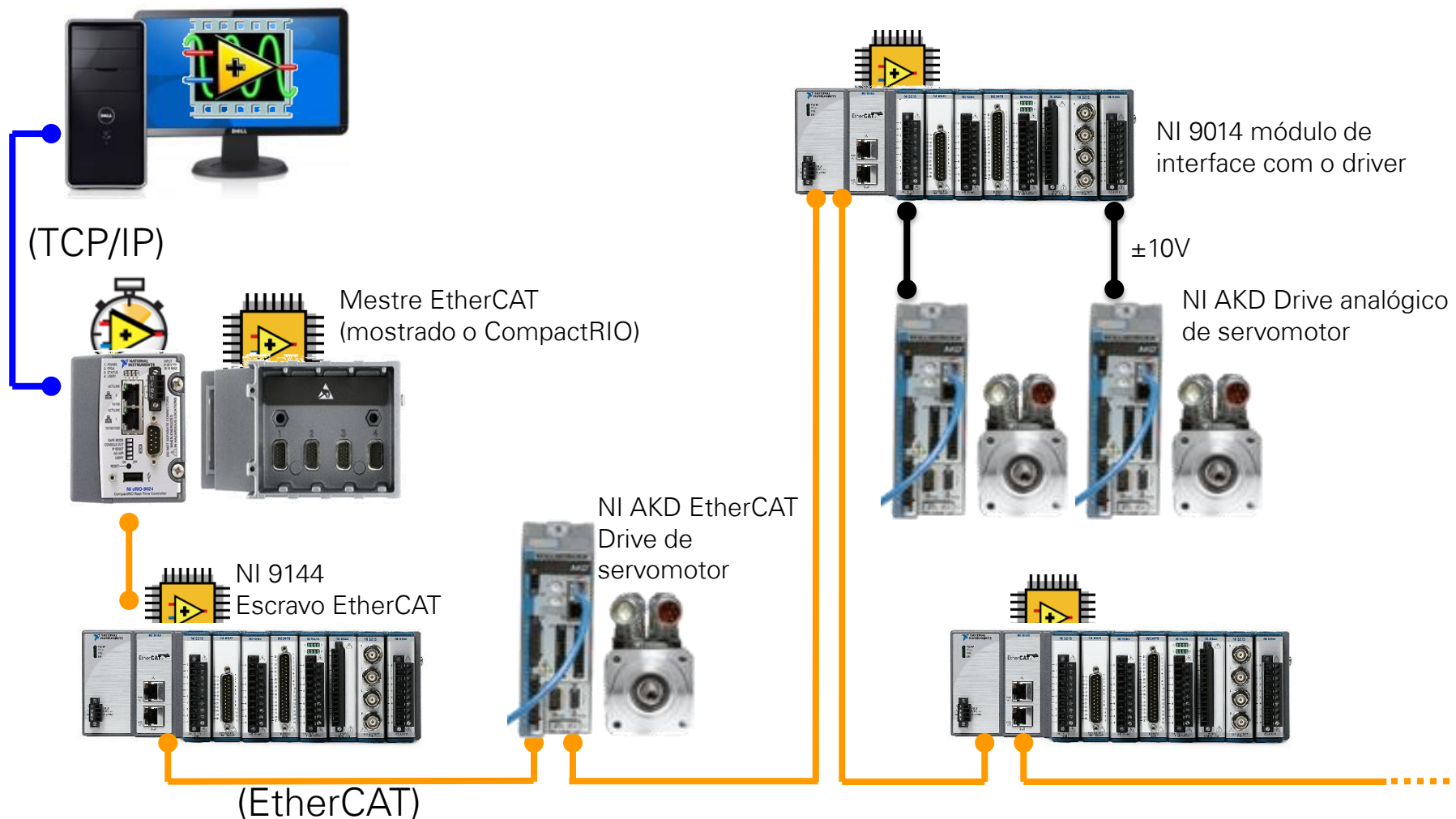
- Decida em qual nível você precisa programar (Windows, RT, FPGA)
- Somente se aprofunde nas áreas que você precisa customizar, abstraia o restante
- Controle completo – implemente IP proprietário
- Um único ambiente para projeto e implementação

## Flexibilidade de hardware

- Uma grande variedade de poder de processamento, dimensões e uma combinação de capacidades
- Permite expansão
- Possibilidade de misturar e combinar tipos de E/S para movimento



# Exemplo de arquitetura de sistema extensível



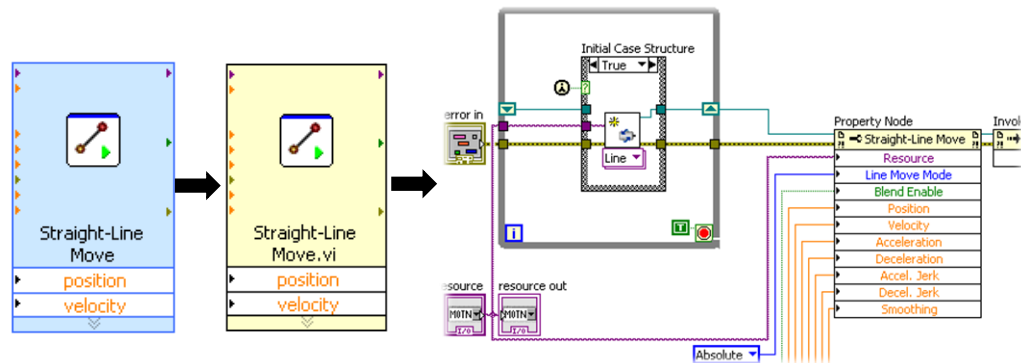
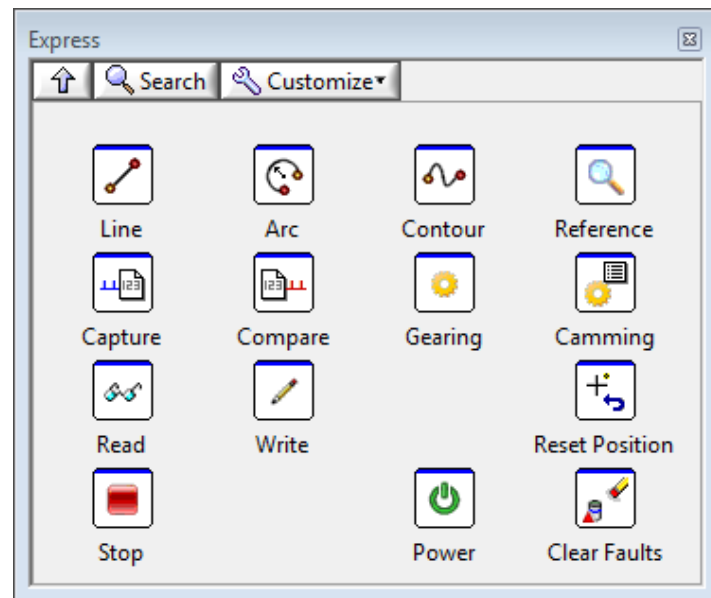
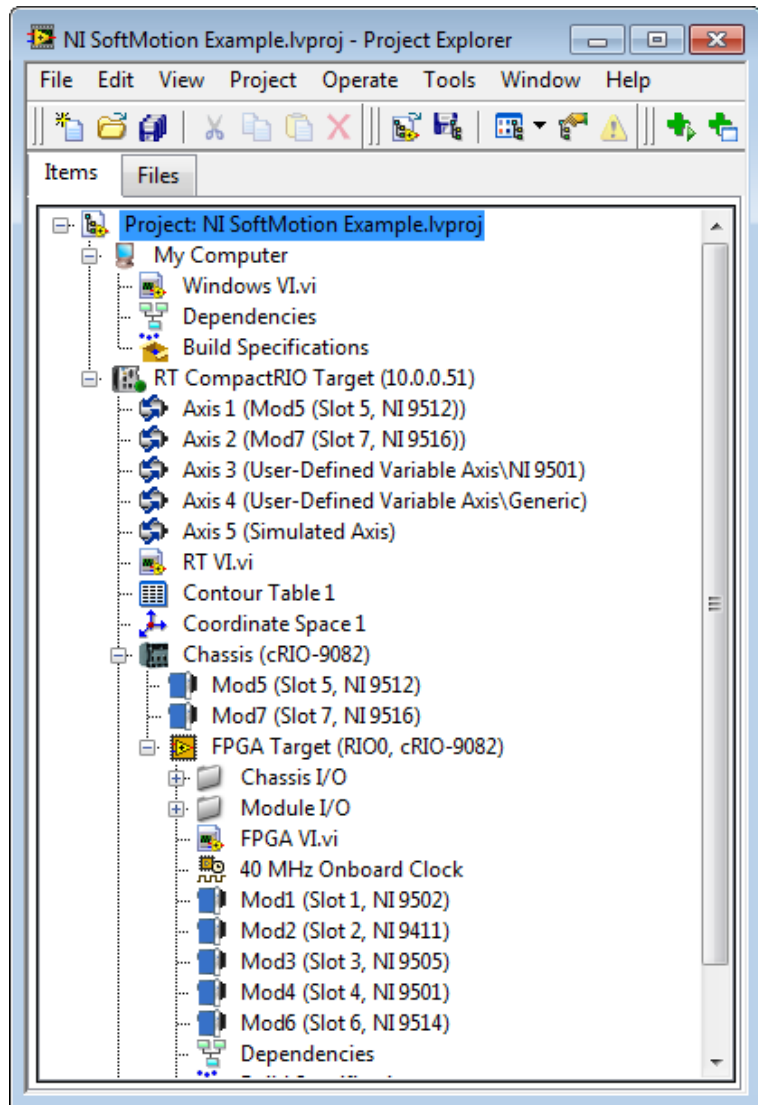
# Configuração do sistema de movimento

The image displays the NI LabVIEW software interface for configuring a multi-axis motion control system. The main window is titled "Untitled Project 2 \* - Project Explorer". The project structure shows a "My Computer" folder containing several components: "Axis 1 (Simulated Axis)", "Axis 2 (Simulated Axis)", "Coordinate Space 1", "Table 1", "Dependencies", and "Build Specifications". A context menu is open over "Axis 1 (Simulated Axis)", listing options such as "Bind to Different Resource", "Interactive Test Panel...", "Gain Tuning Panel...", "Deploy", "Arrange By", "Remove from Project", "Rename...", "Help...", and "Properties". A blue arrow points from the "Properties" option to the "Axis Configuration" window.

The "Axis Configuration" window is open, showing the "General Settings" tab. It includes sections for "General Settings", "Trajectory", "Spline", "Position Loop", "Limits & Home", "Capture", "Drive Enable", and "Compare". The "General Settings" section has a "Type" dropdown set to "Servo Drive Interface", a "Feedback Source" dropdown set to "Encoder 0", and a "Dual-Loop Feedback" checkbox. The "Initial Axis State" section has checkboxes for "Axis Enabled" and "Enable Drive on Transition to Active Mode", both of which are checked. A note states: "Note: If the Axis is not enabled, all outputs will be initialized to safe state on transition to Active Mode." The "Communication Watchdog" section has a "Timeout" of 1 and a "Scan Periods" of 1. The "OK", "Cancel", "Apply", and "Help" buttons are at the bottom.

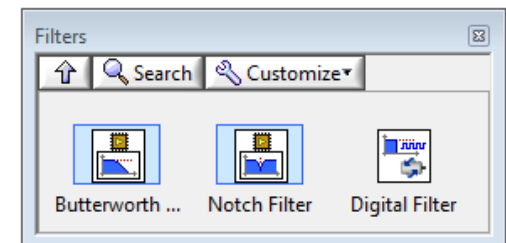
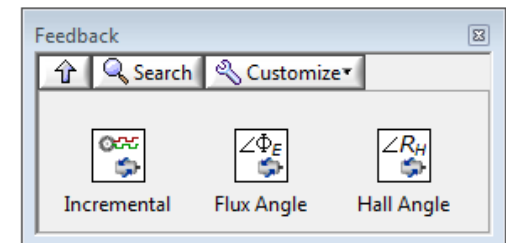
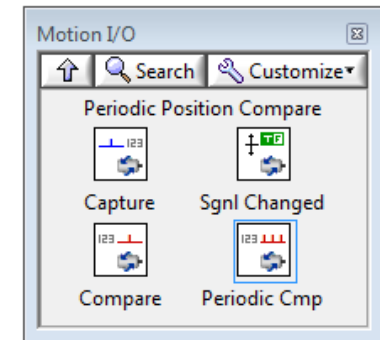
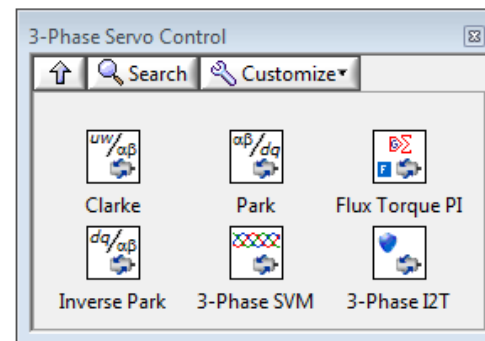
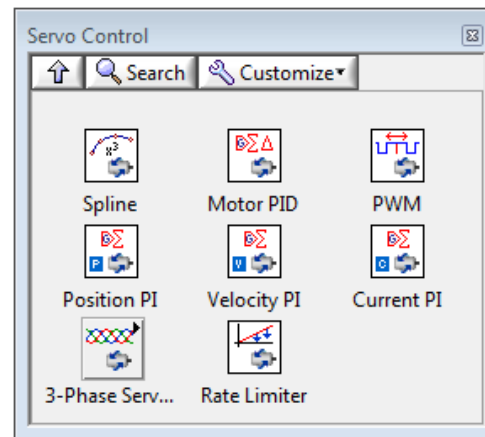
The "Gain Tuning Panel" is also visible, showing a "Position Error" graph and a "Velocity Override" slider. The "Interactive Test Panel" is at the top right, showing a "Drive Enabled" status and a "Position Error" graph. The "Position Error" graph in the Interactive Test Panel has a red curve and is labeled "Gráfico de posição" in red text. The "Position Error" graph in the Gain Tuning Panel also has a red curve and is labeled "Gráfico de posição" in red text.

# Utilizando o NI SoftMotion



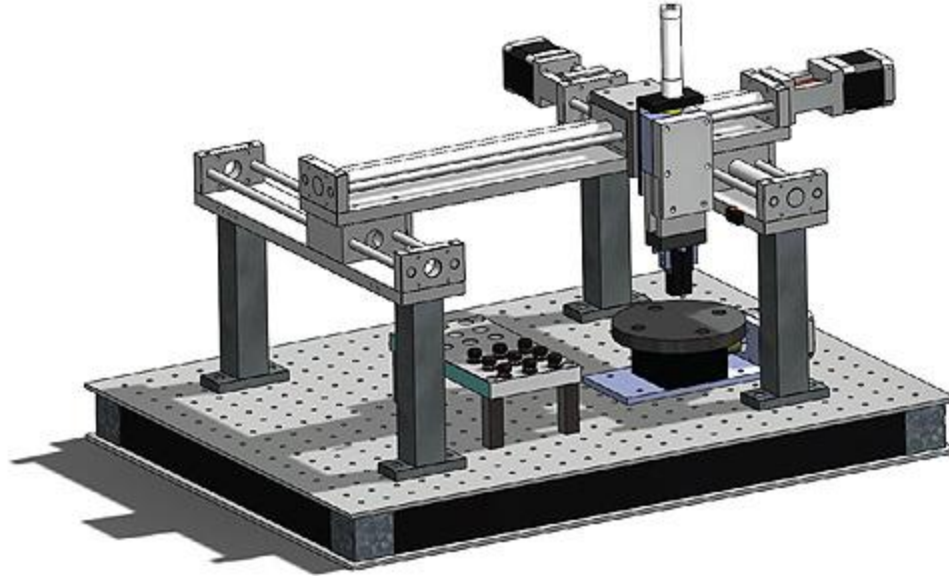
# Programação em FPGA para controle de motor com o NI SoftMotion

- ✓ PID / PI
- ✓ PWM
- ✓ FOC
- ✓ I<sup>2</sup>T
- ✓ E/S para movimento
- ✓ Realimentação
- ✓ Filtros
- ✓ Geração de passos



\* For LabVIEW FPGA

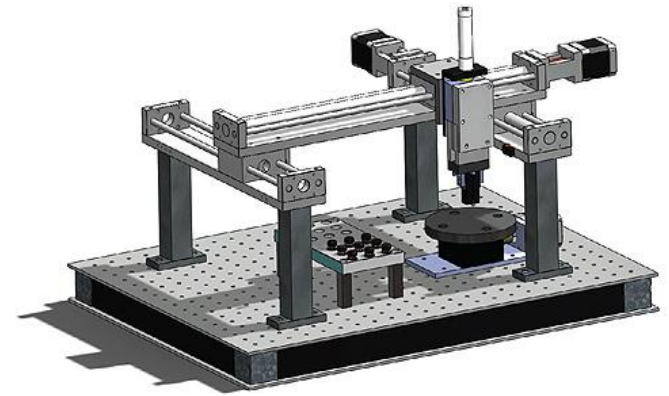
# Exemplo de requisitos de projeto



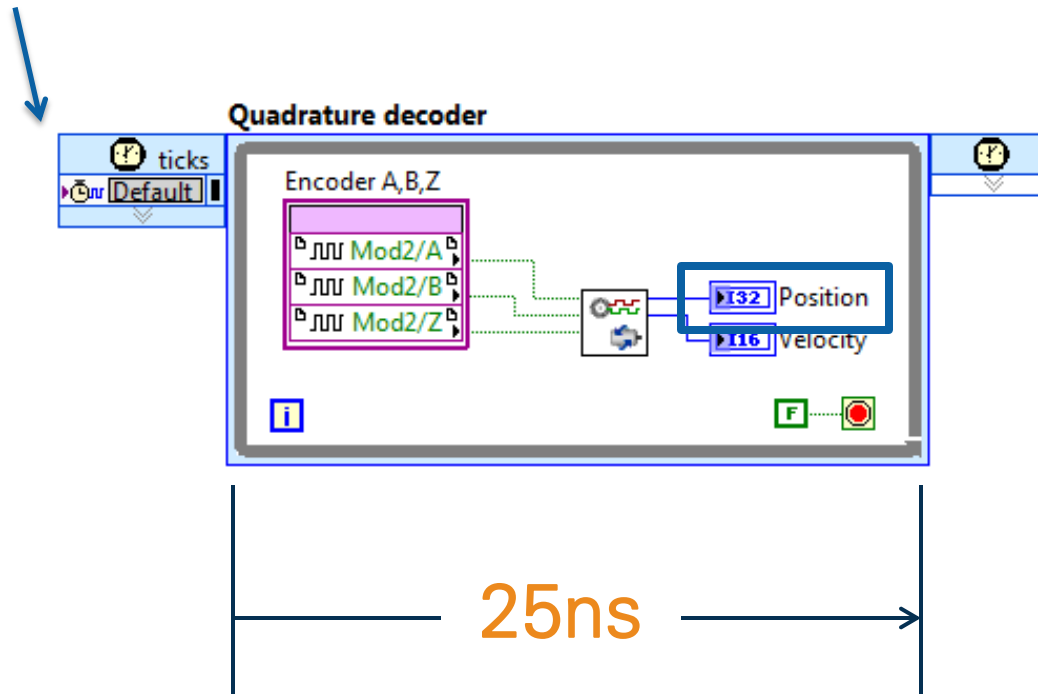
Precisa-se acionar uma garra com base em múltiplas condições:

1. Posição do cavalete (X, Y & Z)
2. Ângulo de rotação do estágio
3. Força exercida pela garra

# Posição a partir do encoder

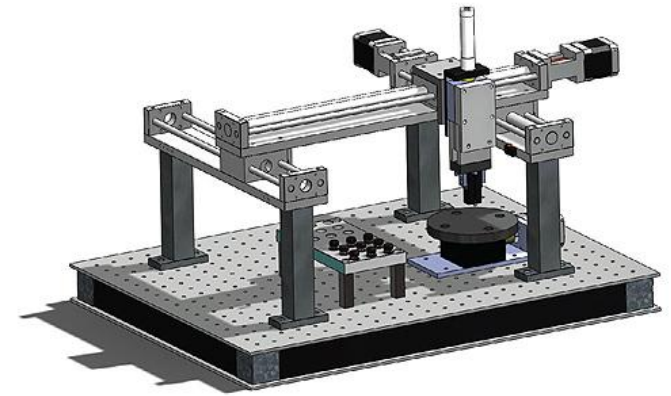


Timed Loop de um único ciclo

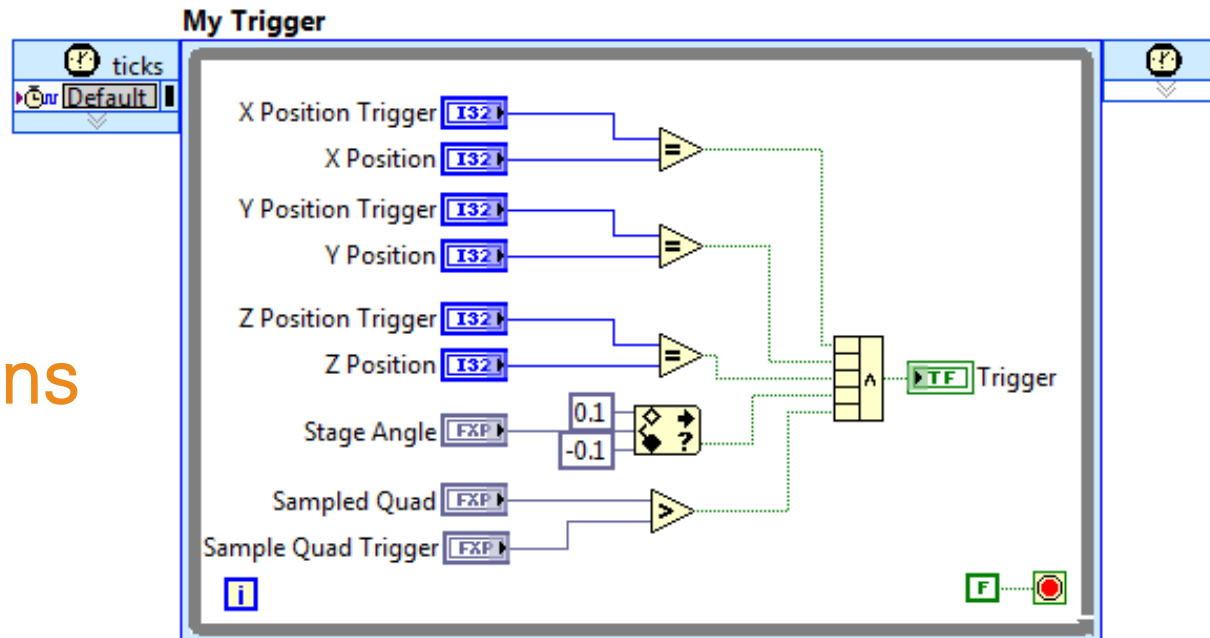




# Trigger definido pelo usuário



25ns

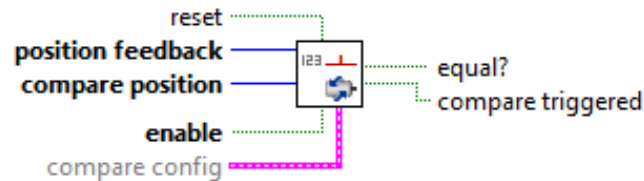




# IP de SoftMotion para Trigger

## Position Compare

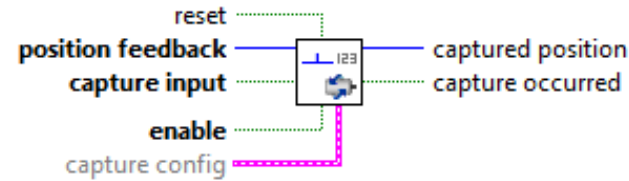
[C:\...2012\vi.lib\Motion\MotorControl\nism.compare.2.vi]



Performs a single position compare operation.

## Position Capture

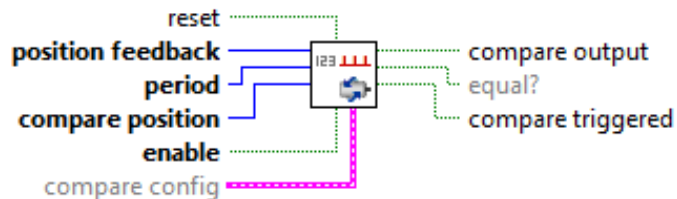
[C:\...ts\LabVIEW 2012\vi.lib\Motion\MotorControl\nism.capture.2.vi]



Performs a position capture operation using the specified parameters.

## Periodic Position Compare

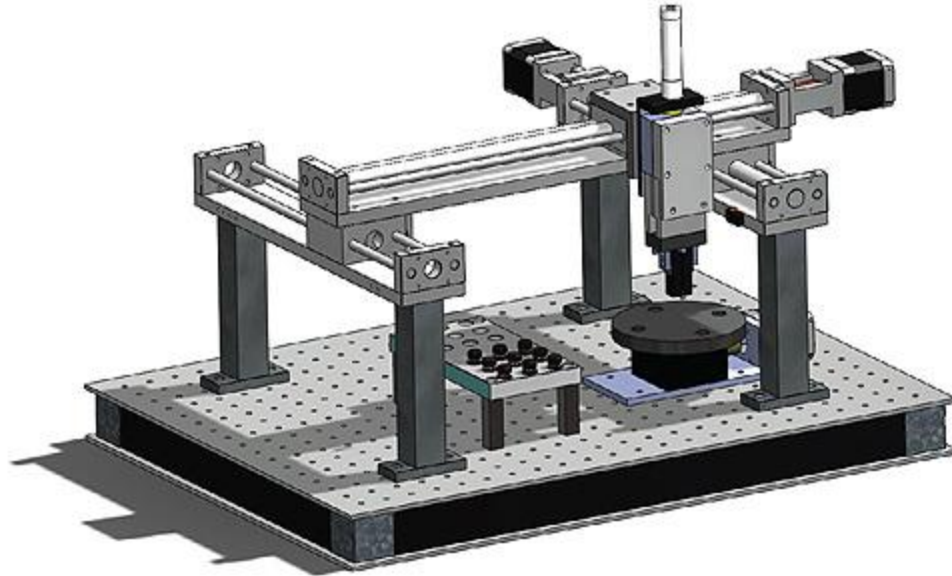
[C:\... 2012\vi.lib\Motion\MotorControl\nism.compare.periodic.2.vi]



Performs a periodic position compare operation, with a user-specified period and compare window.

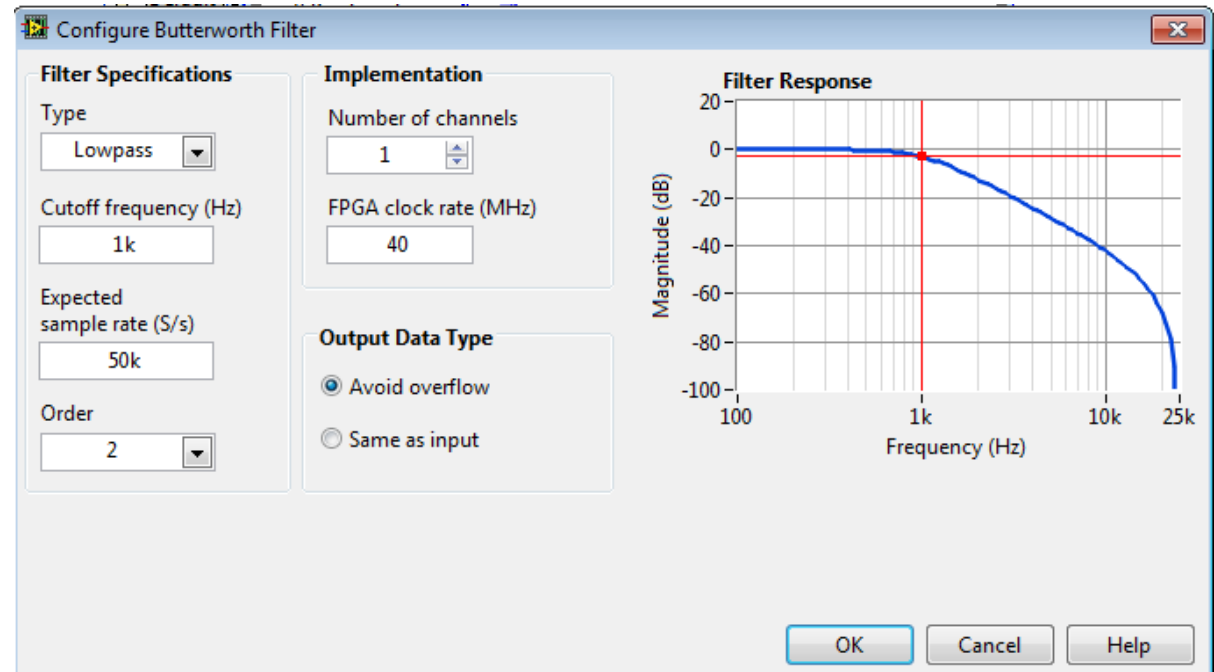
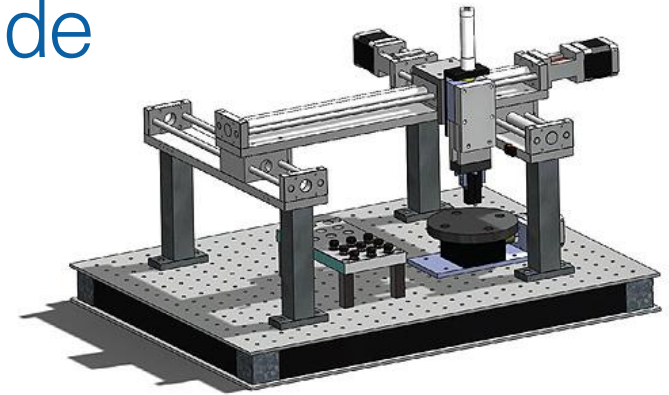
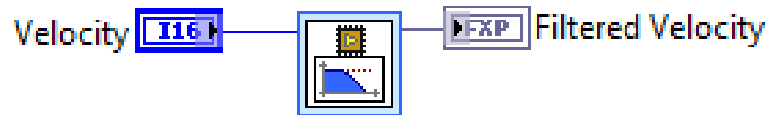
- ✓ Habilitar/deshabilitar
- ✓ Largura de pulso
- ✓ Trigger periódicos
- ✓ Filtro digital
- ✓ Janela de trigger
- ✓ Compatível com SCTL
- ✓ Aberto

# Validando o sistema



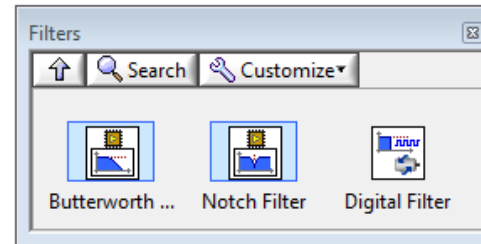
Durante a validação, a **vibração** do ambiente externo resulta em **instabilidade na velocidade**, a partir da leitura do encoder. Isso torna difícil controlar e analisar a velocidade.

# Adicionar um filtro de velocidade



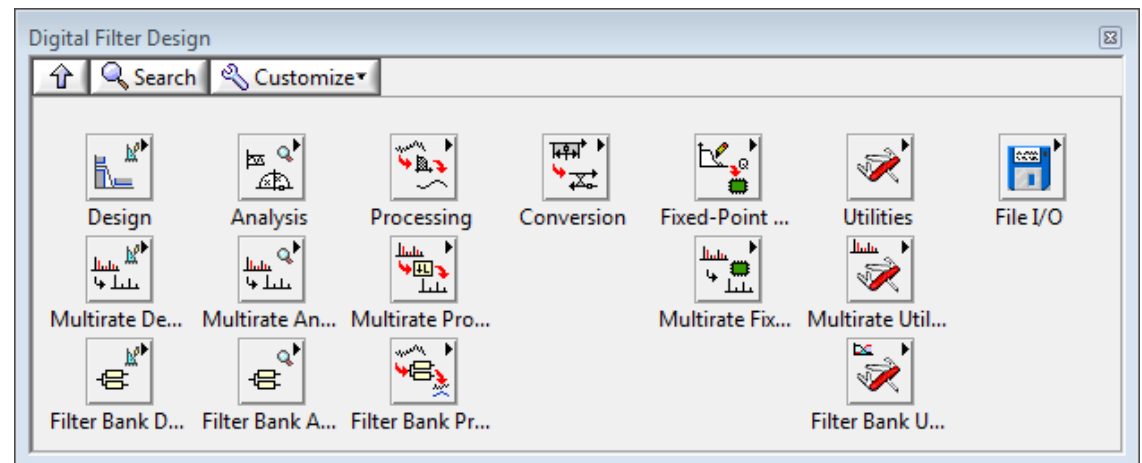
# IP do LabVIEW para filtros

- ✓ Filtro Butterworth
- ✓ Filtro Notch
- ✓ Filtro digital simples



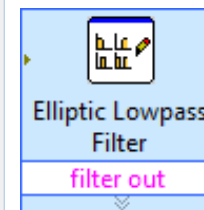
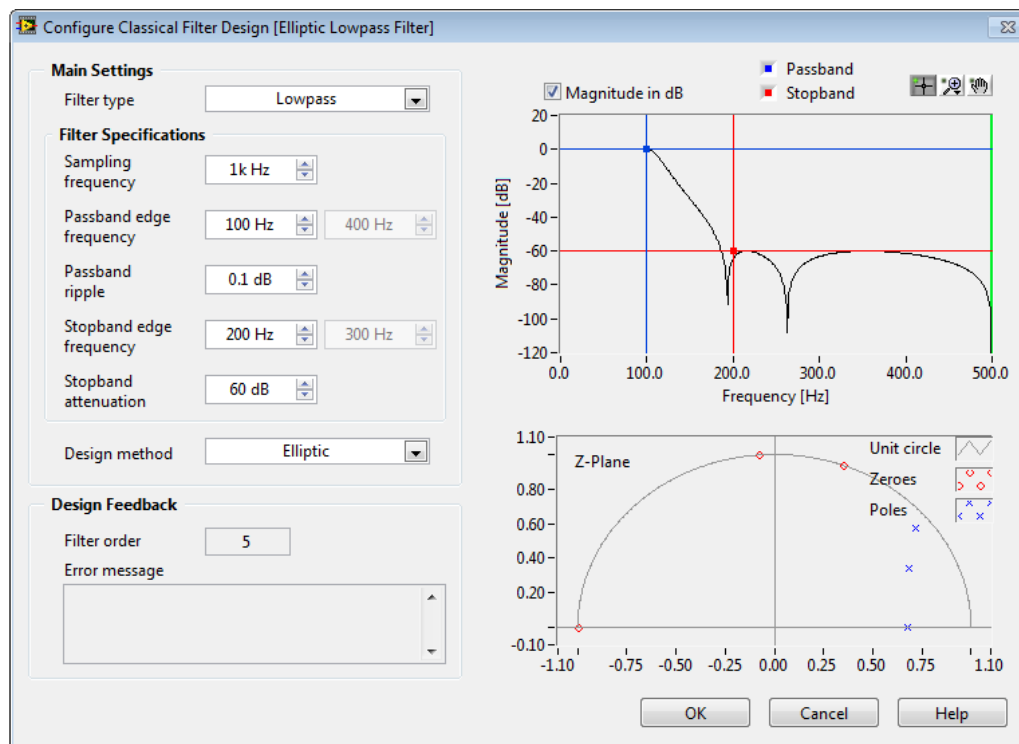
\* O filtro digital simples requer o NI SoftMotion

- ✓ Projeto
- ✓ Análise
- ✓ Processamento
- ✓ Ponto fixo
- ✓ Multitaxa

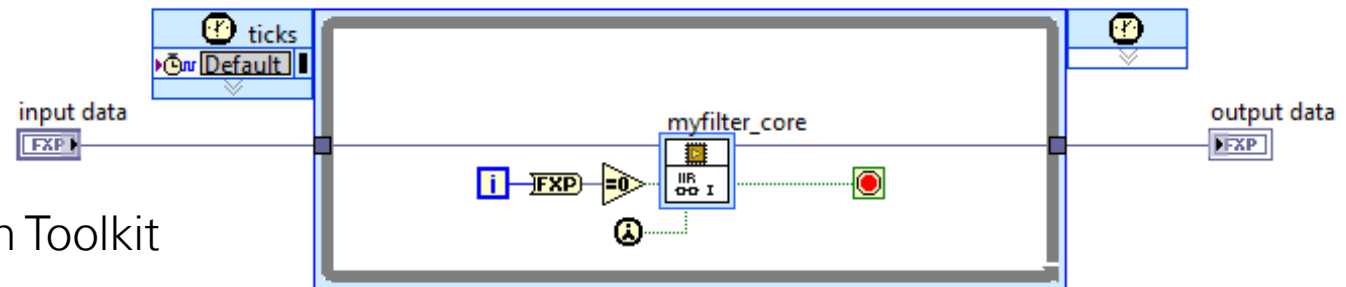


\* Requer o Digital Filter Design Toolkit

# Projetar filtros e gerar o código para o FPGA



Gerar o código para o FPGA



\* Digital Filter Design Toolkit

# Lembrete

A arquitetura LabVIEW RIO e o NI SoftMotion fornecem um método revolucionário para integrar firmemente os subsistemas especializados, a fim de construir máquinas de alto desempenho

PC



Controlador Real-Time



FPGA programável



E/S para movimento



LV-Windows

API de movimento

LV Project

Target com LV-RT

API de movimento

Gerenciador do  
SoftMotion

LV-FPGA

IP para SoftMotion

E/S

NI 951x, 950x, ...

Série R, Flex-RIO

Drives EtherCAT