

LabVIEW and Single-Board RIO to Control a Quadcopter

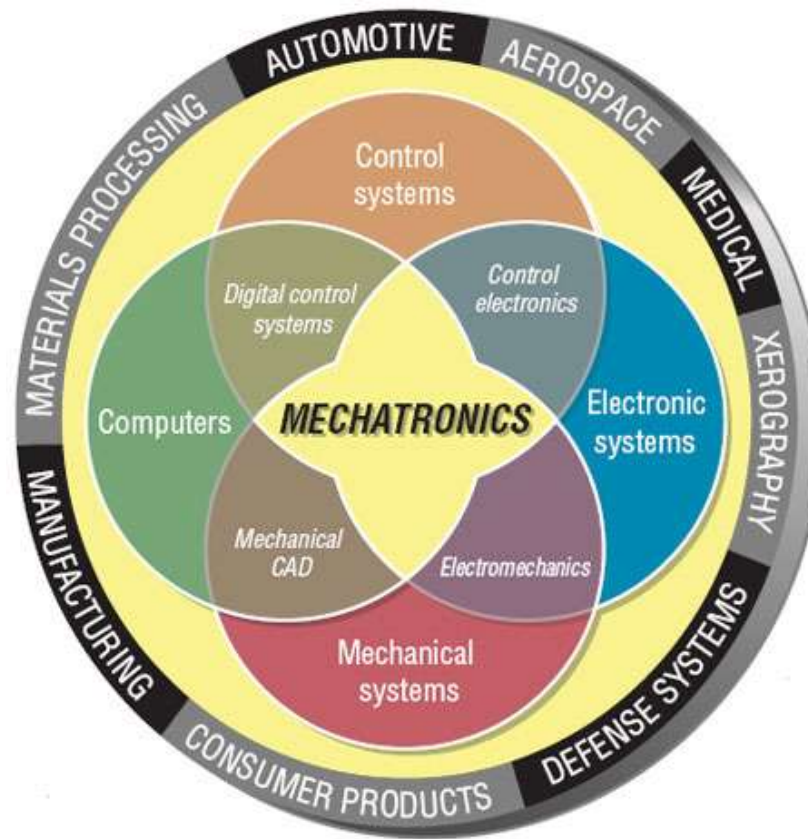


Universitetet i Agder, Grimstad

- Øyvind Magnussen
 - Master i Mekatronikk (2011)
 - PhD Mekatronikk
- Hva er mekatronikk?



- «Mekatronikk»
- «Meka-hva-for-no?»



Intro – Problemstillinger

- Søk etter personer



Intro – Problemstillinger

- Søk etter personer
- Kraftlinjer



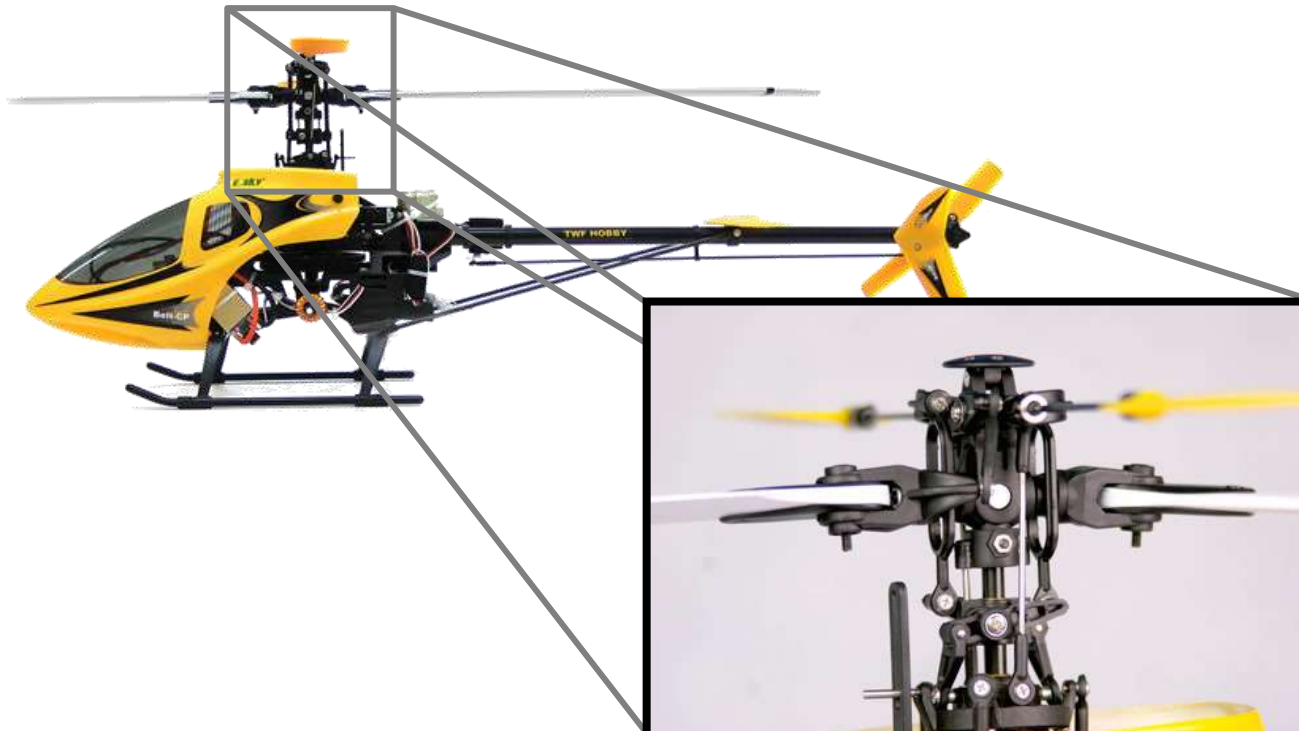
Intro – Problemstillinger

- Søk etter personer
- Kraftlinjer
- Overvåkning



Intro – Løsning?

- Helikopter



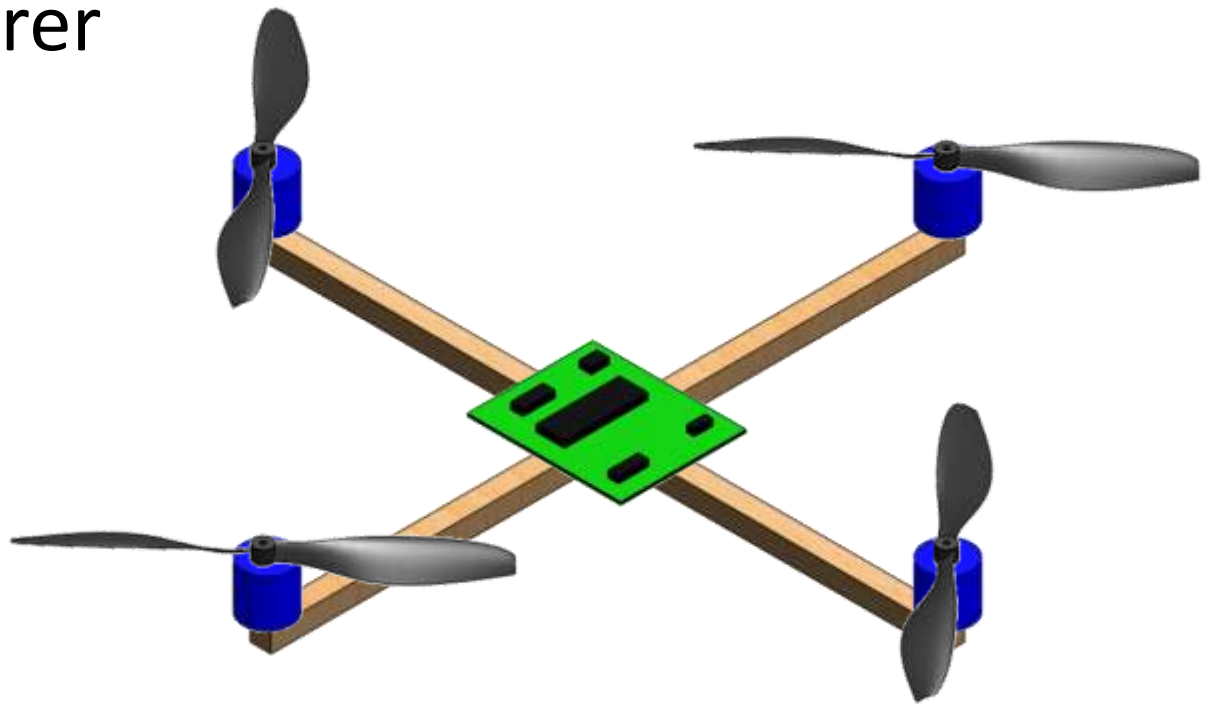
Intro – Løsning?

- Helikopter
 - Mekanisk komplisert
 - Dyrt!
 - Skjørt
 - Mye vibrasjon



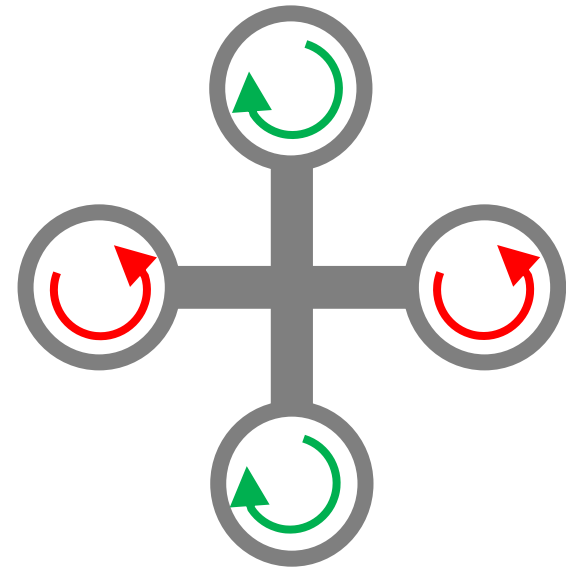
Intro – Quadcopter

- Enkel konstruksjon
- Flere motorer
- Solid
- Kontroller



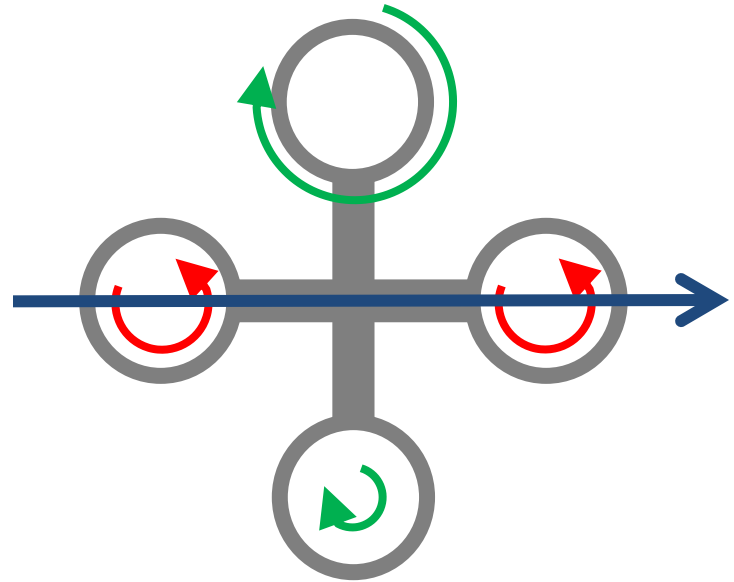
Kontroll

- Posisjon
 - X
 - Y
 - Z
- Vinkel
 - Roll
 - Pitch
 - Yaw



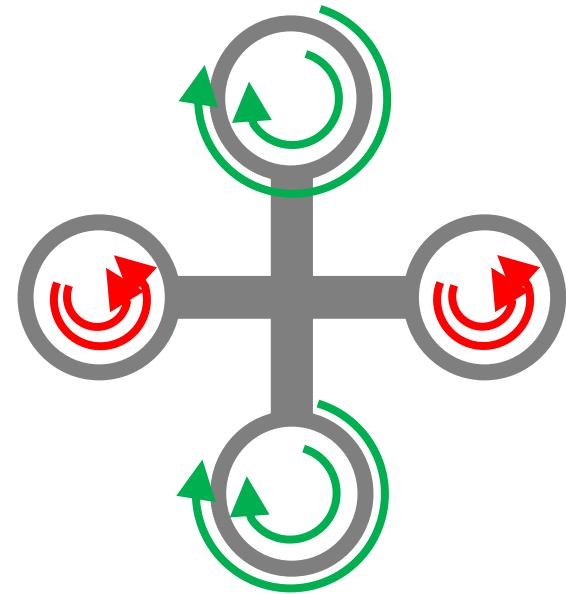
Kontroll

- Vinkler
 - Roll
 - Pitch



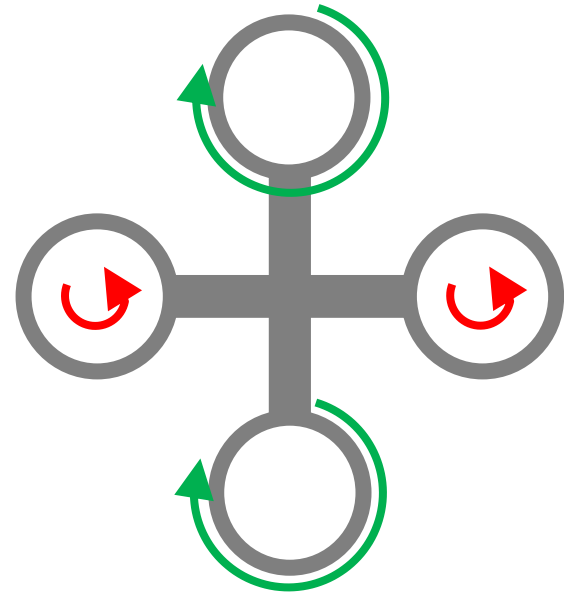
Kontroll

- Vinkler
 - Roll
 - Pitch
 - Yaw



Kontroll

- Vinkler
 - Roll
 - Pitch
 - Yaw



Kontroll

- Vinkler
 - Pitch
 - Roll
 - Yaw
- Posisjon
 - z  
 - X, Y
 - Underaktuert!

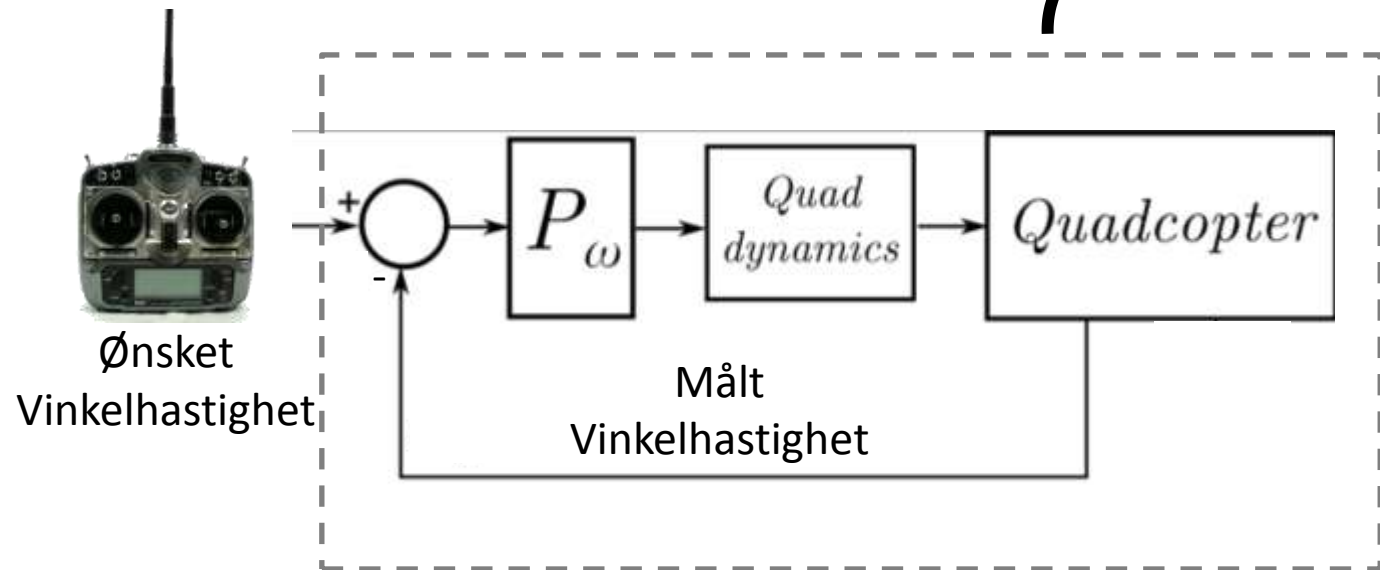


Kontrollsystem

- Helikopter er stabilt
- Quadcopter er ustabilt...

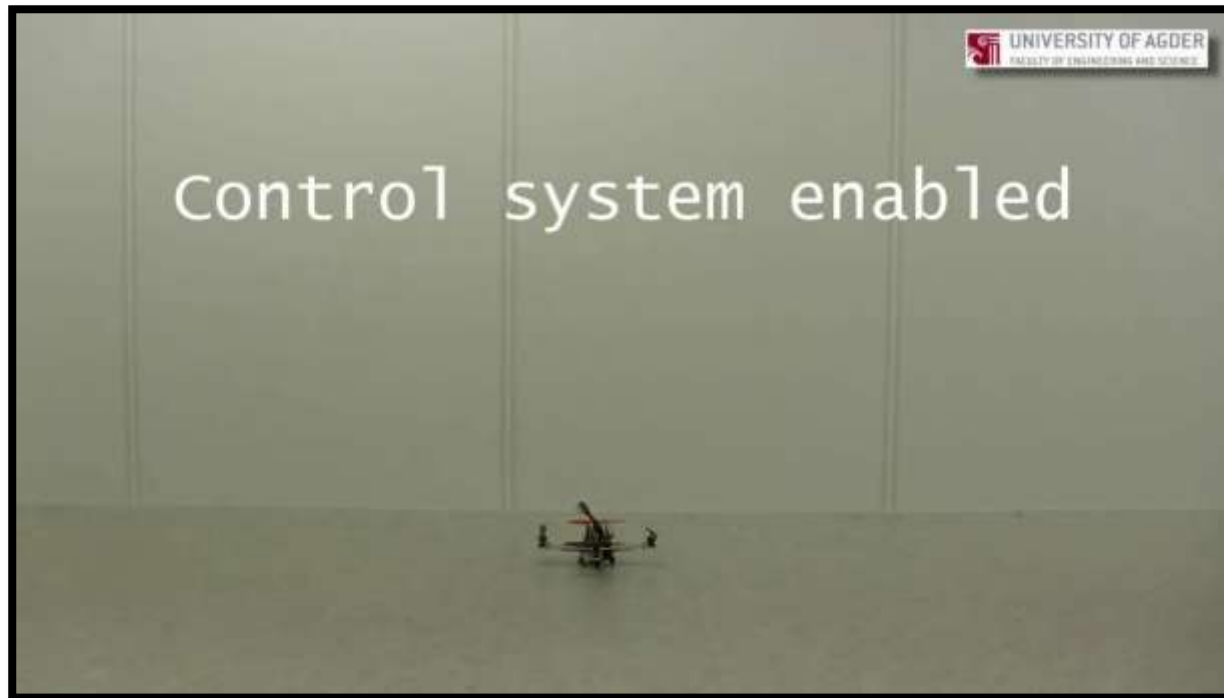


Kontrollsystem

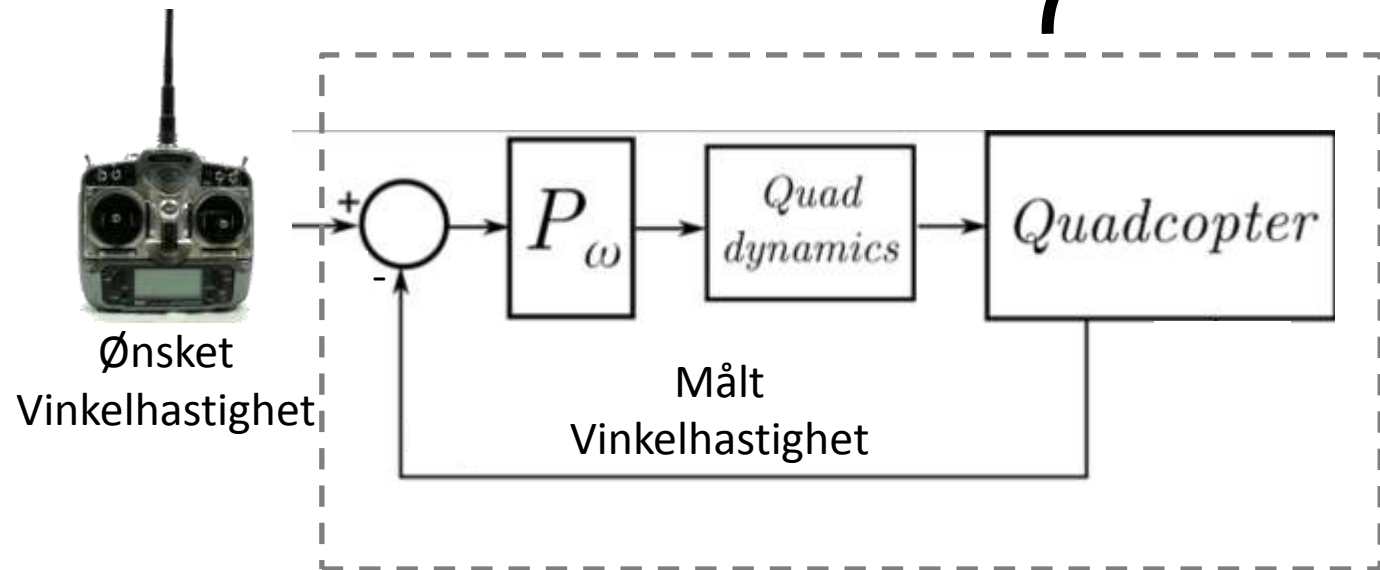


Kontrollsystem

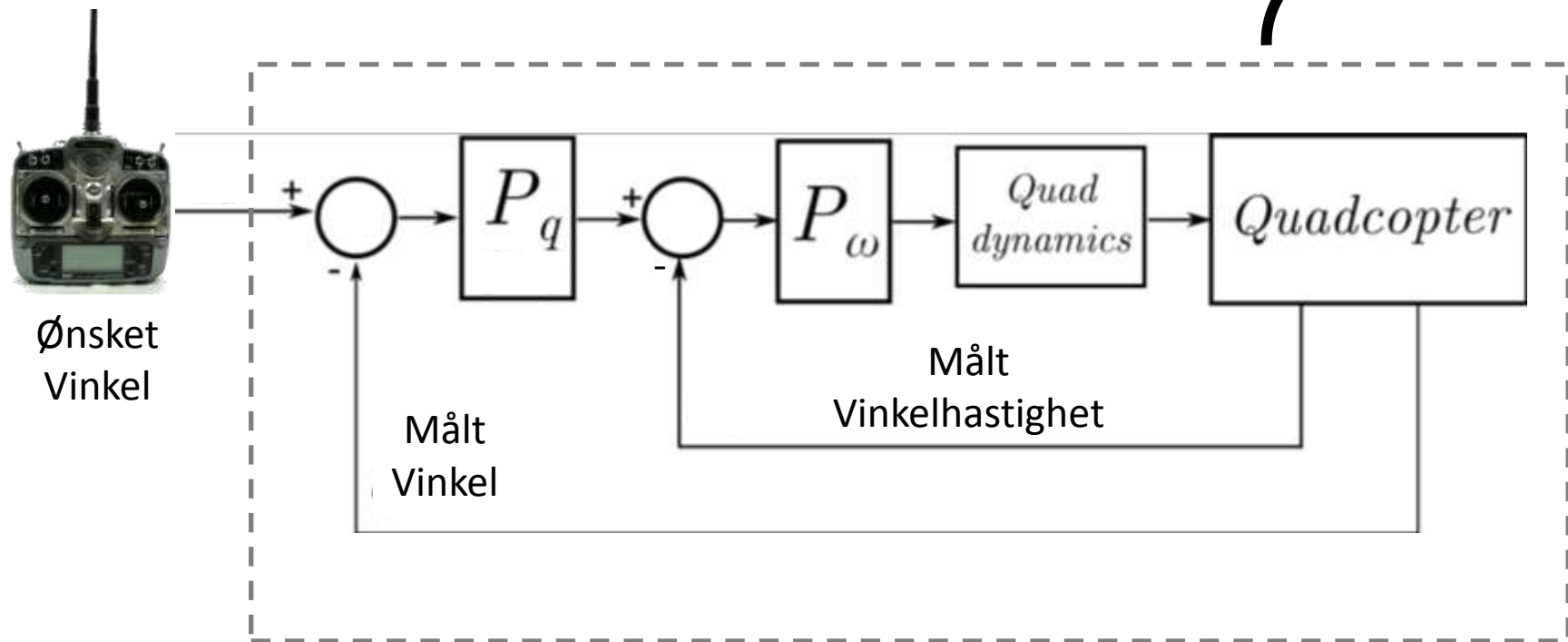
- Stabilt ved kontroll av vinkelhastighet



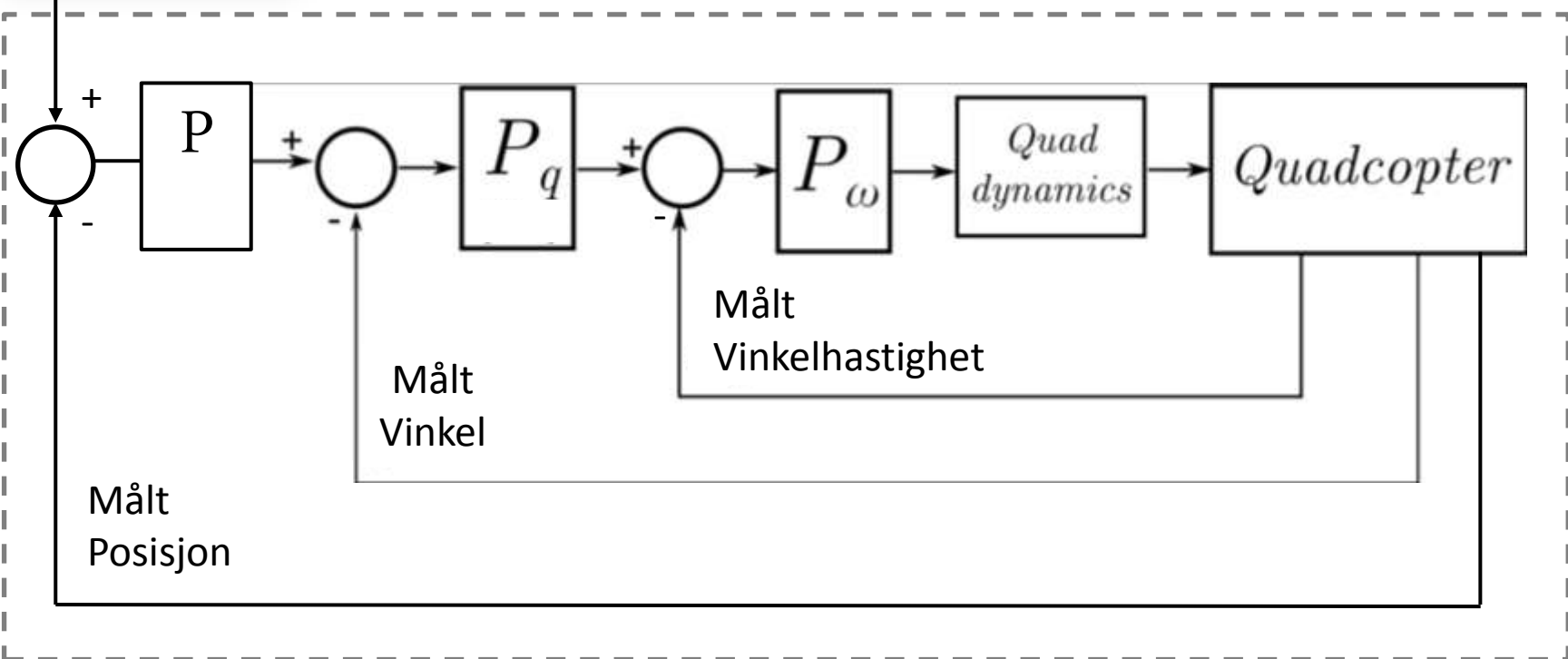
Kontrollsystem



Kontrollsystem

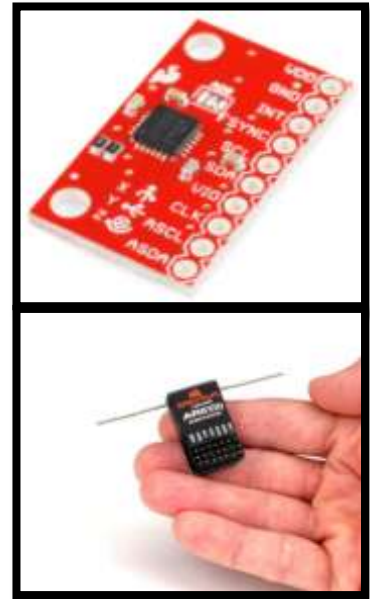


Kontrollsystem



Kontrollsystem - Sensorer

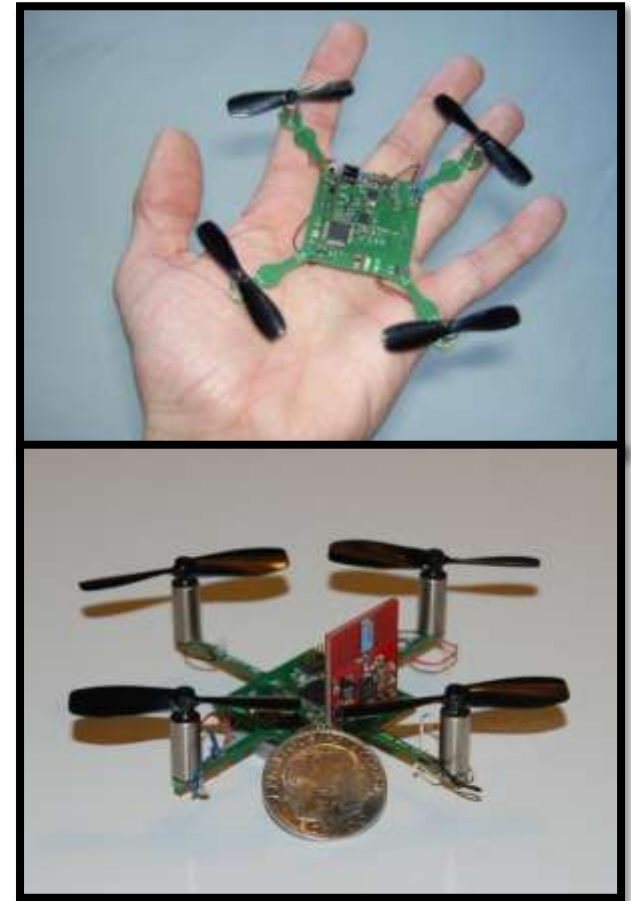
- Vinkelhastighet - Gyroskop
- Vinkel - Akselerometer
- Styringsenhet - Fjernkontroll



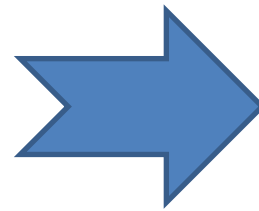
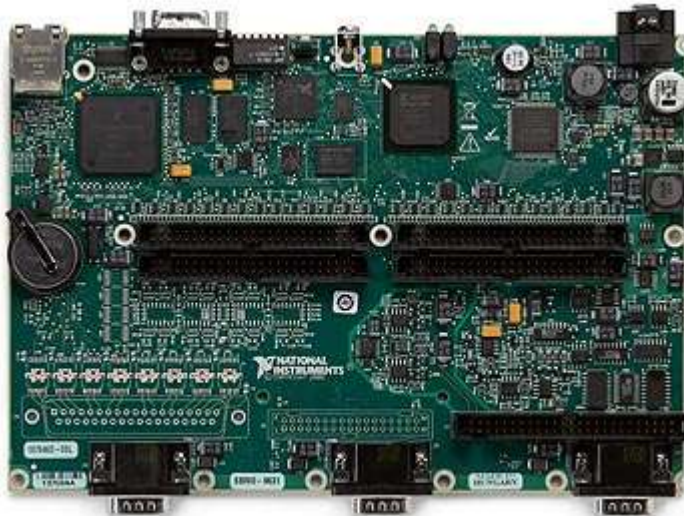
- Kontrollbrett – Single Board RIO (så klart! 😊)

Designkrav

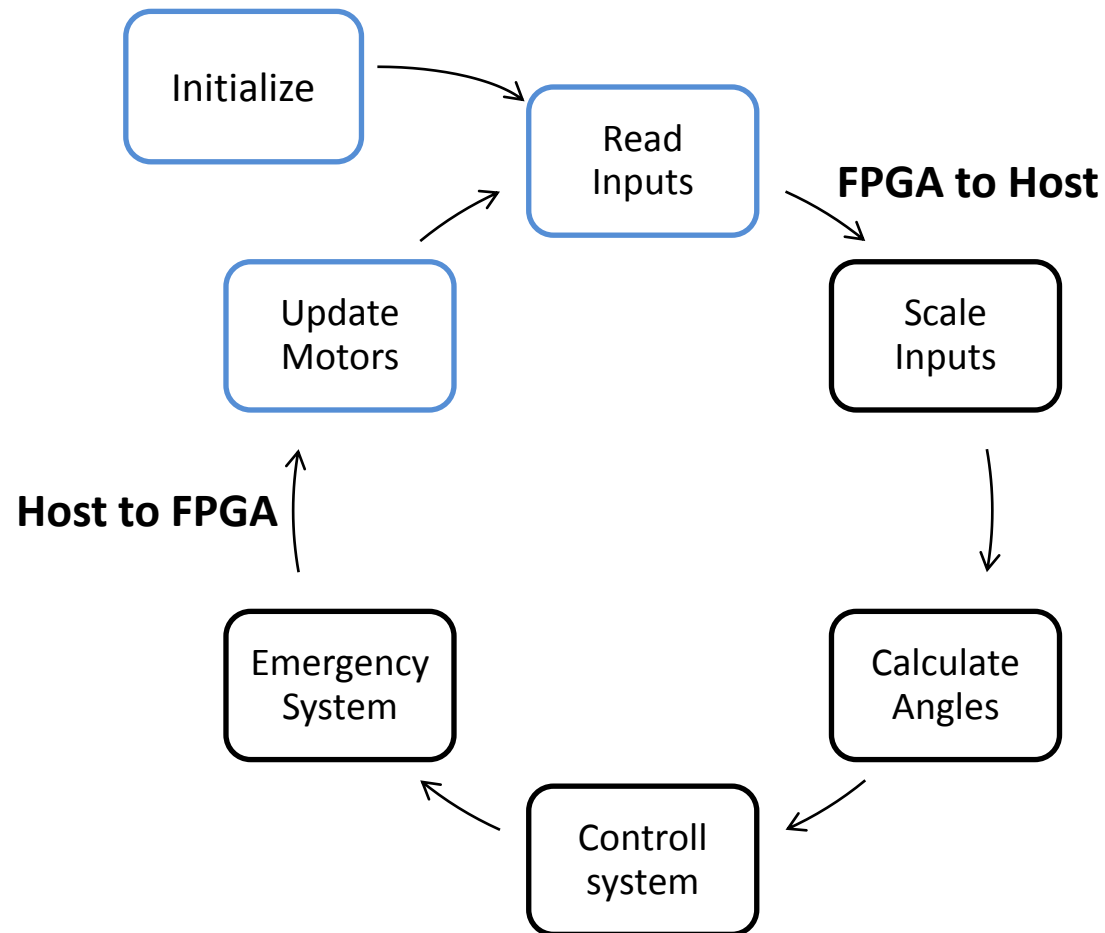
- Størrelse < 2kg
- Mindre = bedre
 - Moment = kraft*arm
 - Tregghetsmoment = $C \cdot \text{arm}^2$
- Motorkontroller > 150Hz



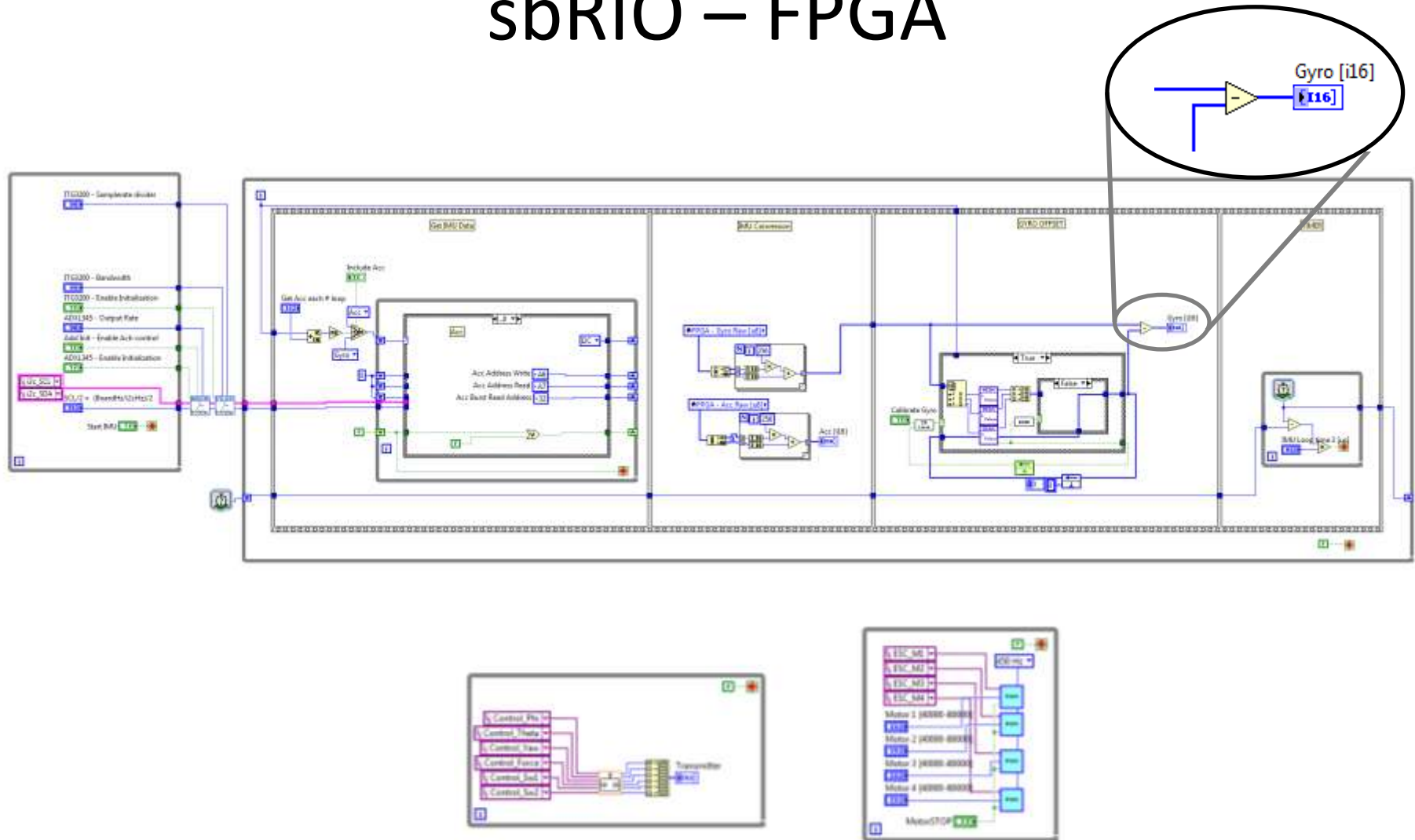
sbRIO



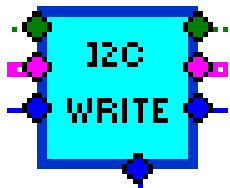
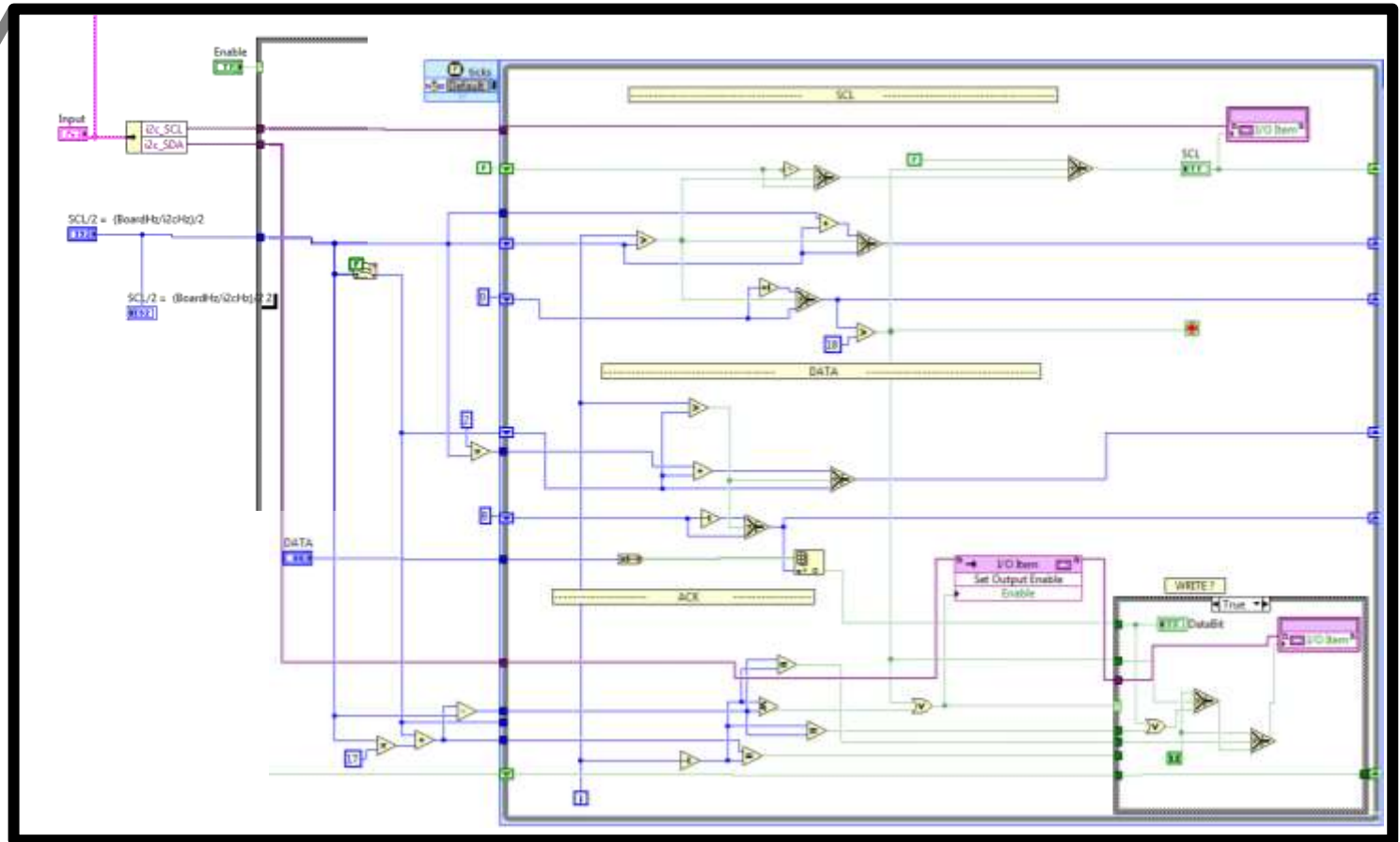
sbRIO – Programflyt



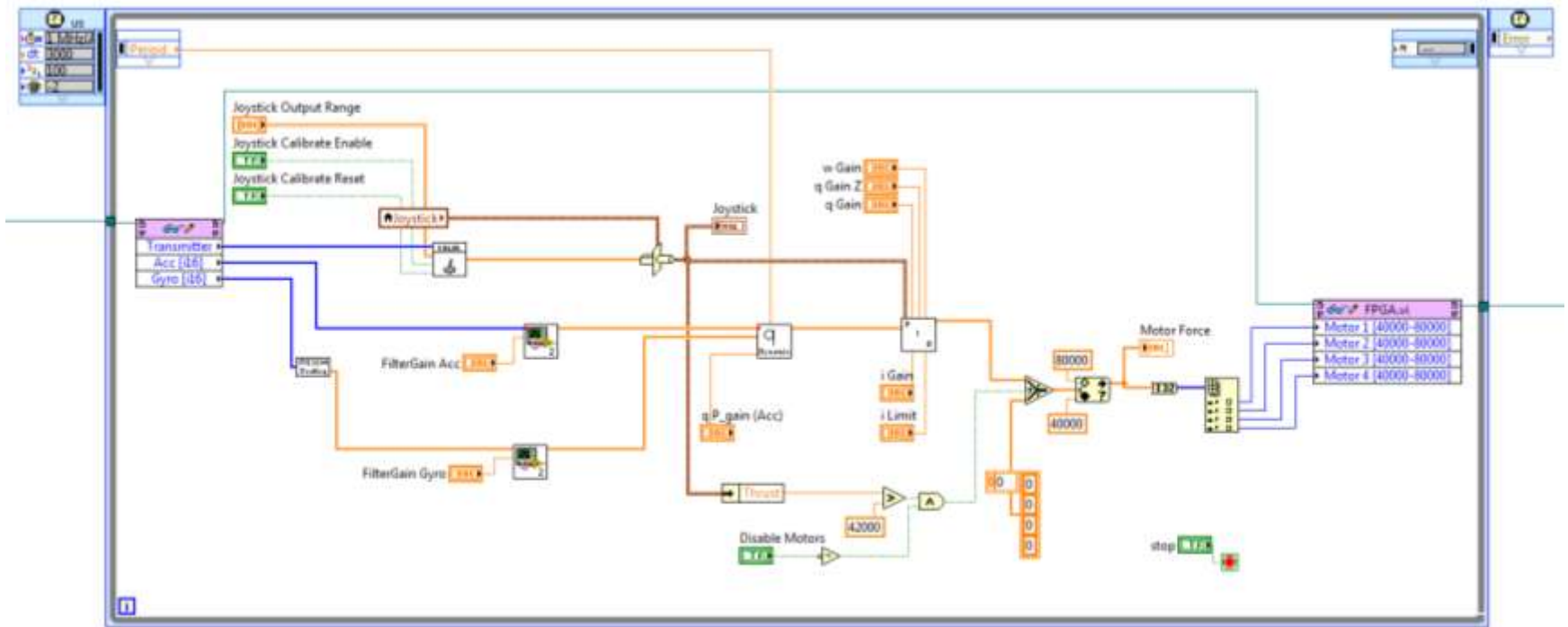
sbRIO – FPGA



sbRIO – FPGA

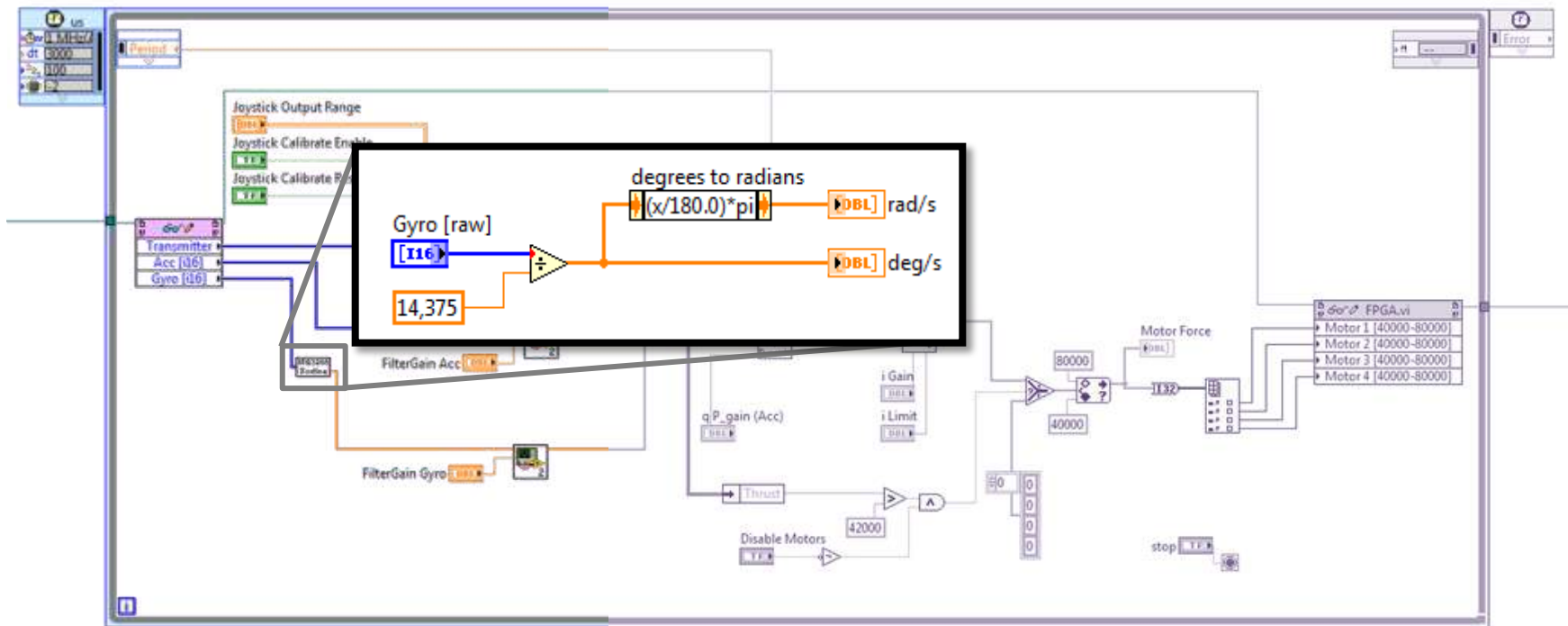


sbRIO – Host



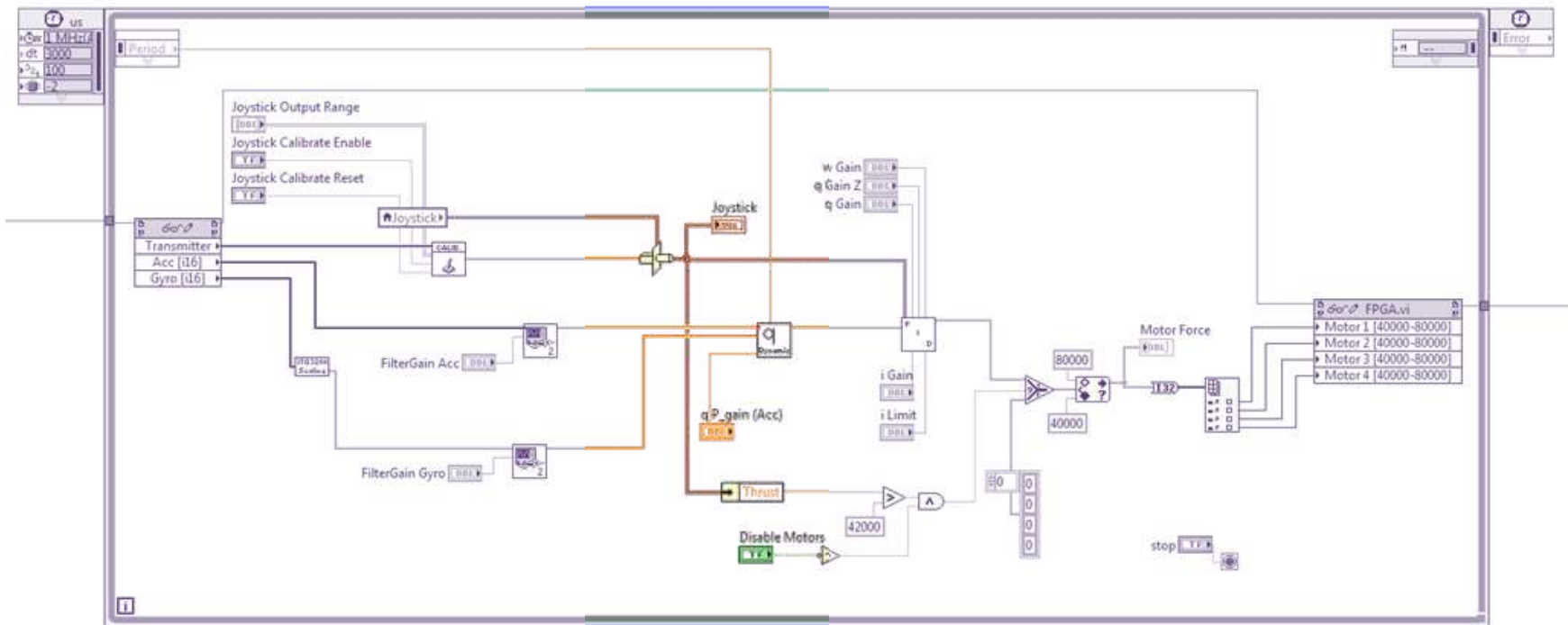
sbRIO – Host

Skalering



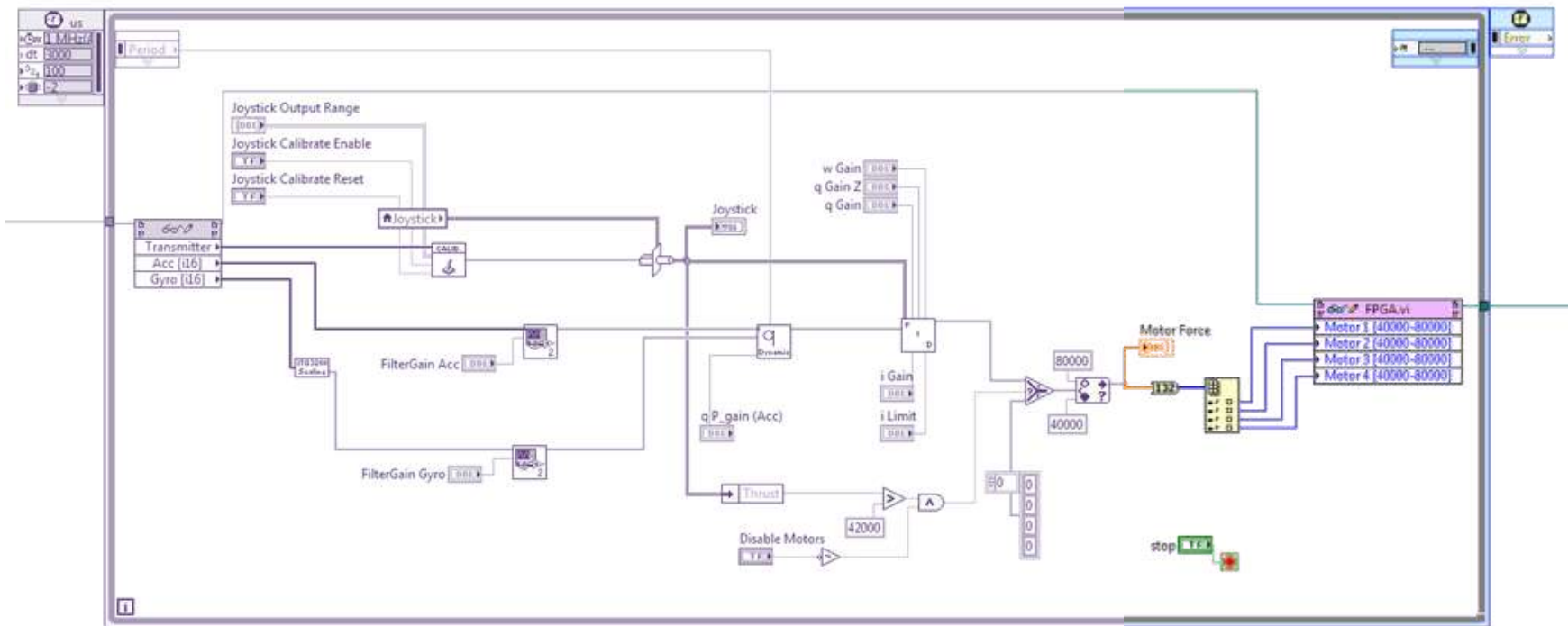
sbRIO – Host

Vinkel
estimering



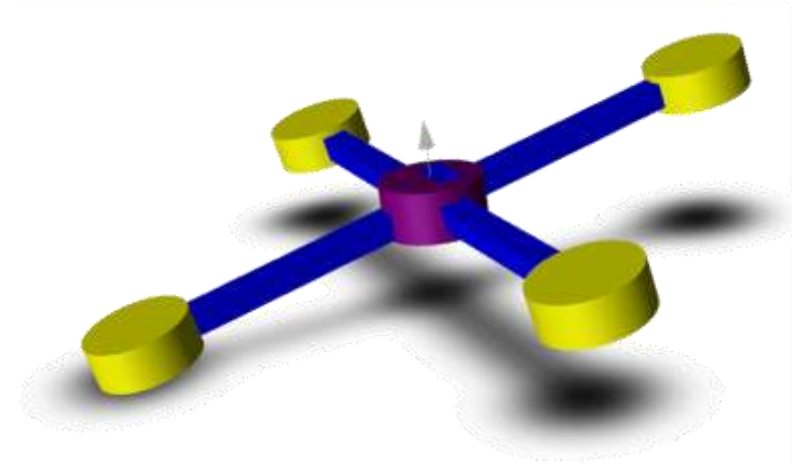
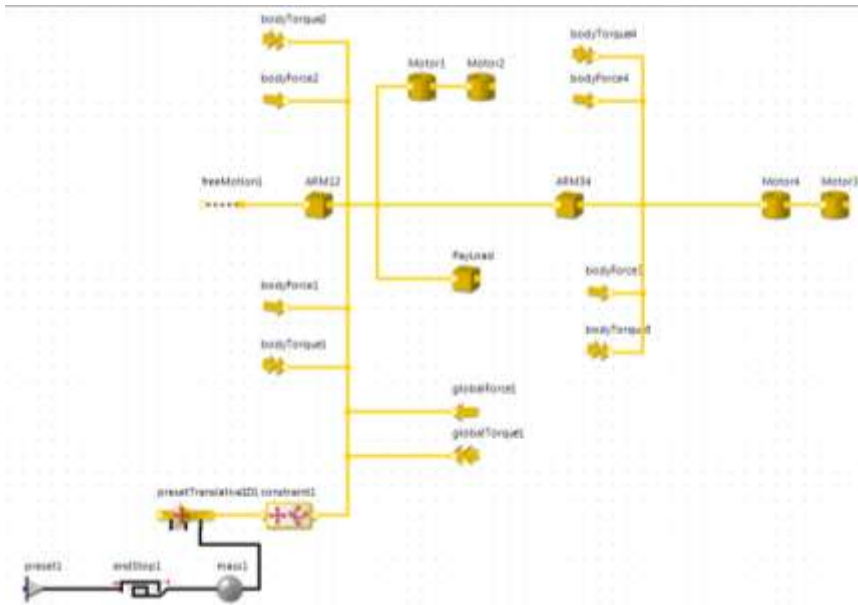
sbRIO – Host

Oppdatere motorene
(FPGA)

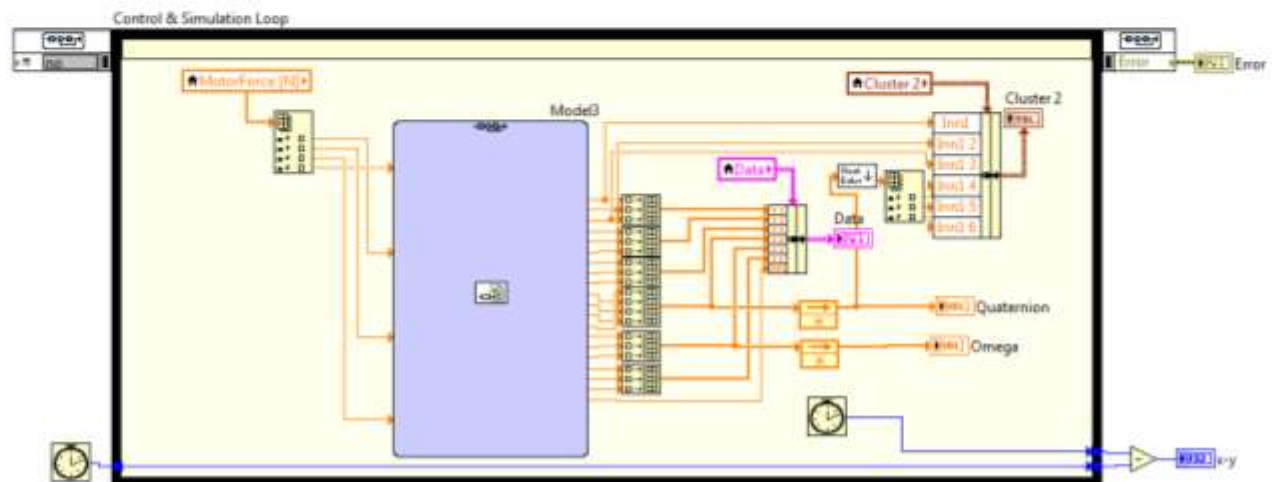
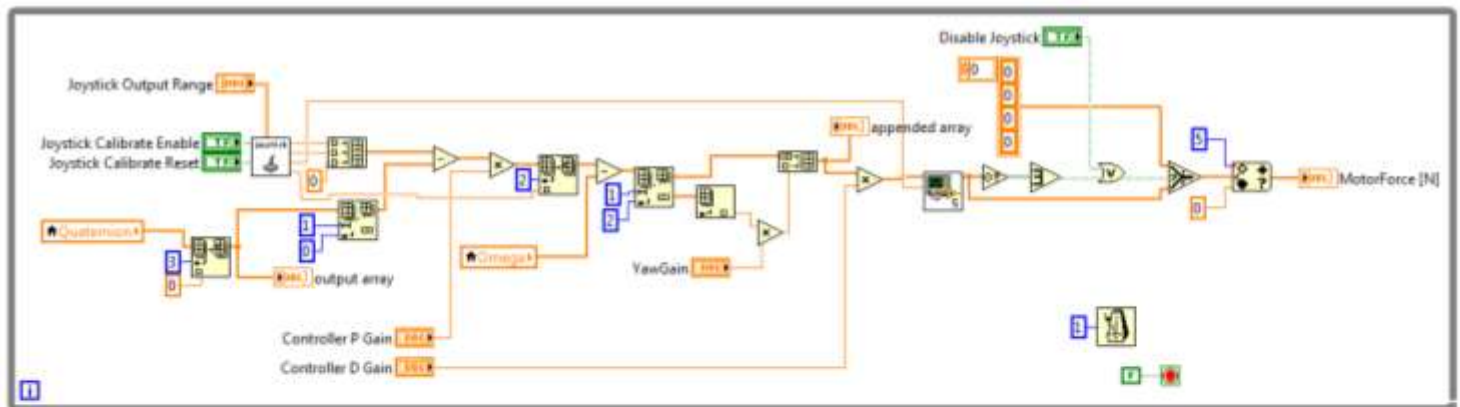


Simulering – SimulationX

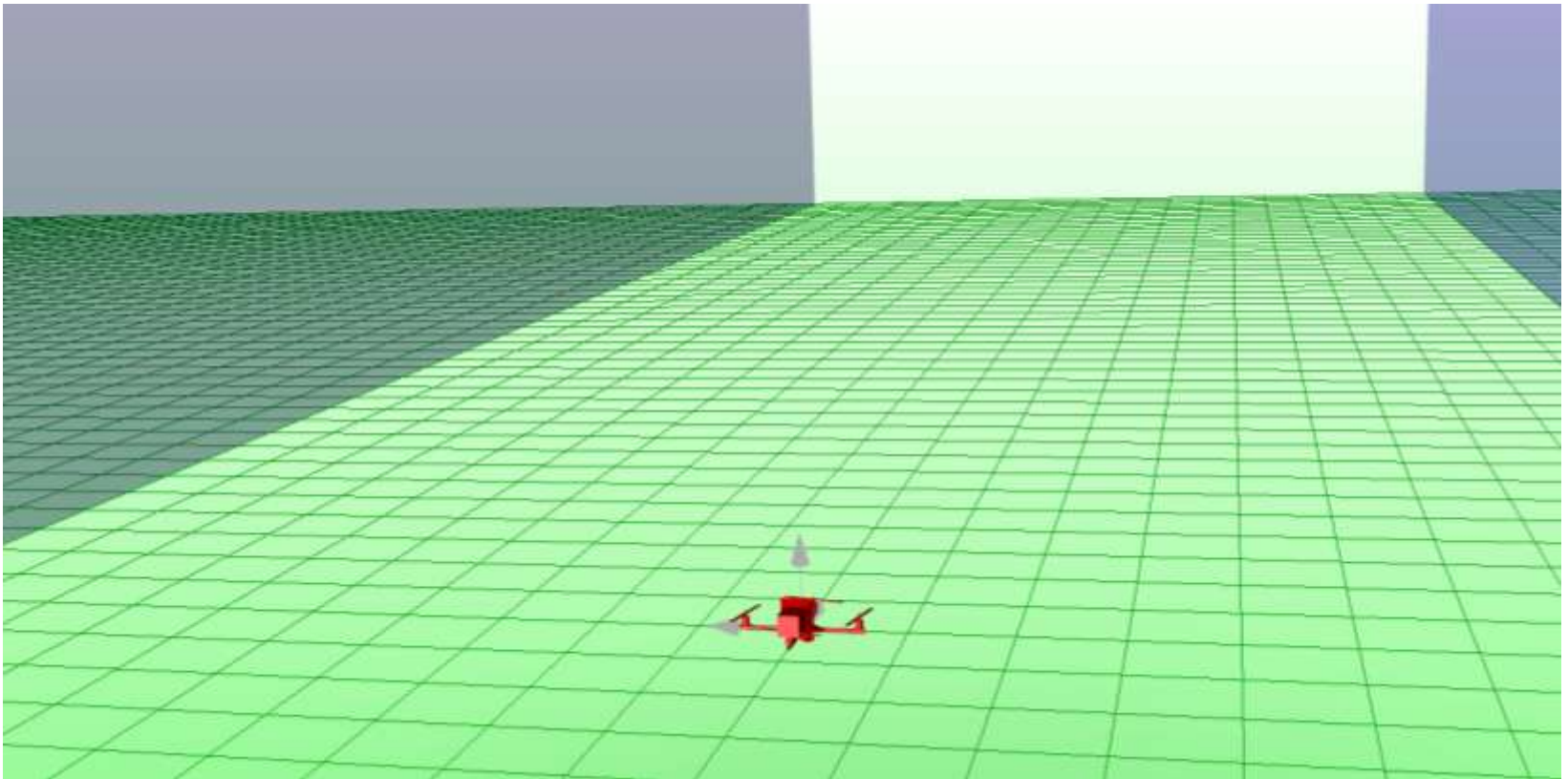
- Likninger for hånd
- Likninger basert på CAD-Modell



Simulering – SimulationX



Simulering – SimulationX

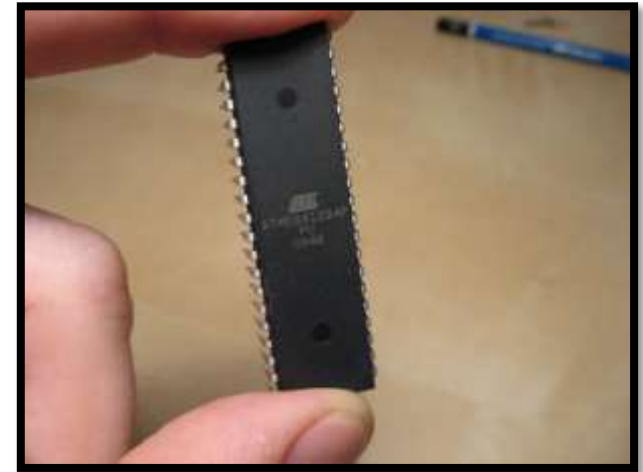


Testing! 😊



Hvorfor LabVIEW & sbRIO?

- Dyrt!
 - Mikrokontroller = 30kr...
- Tung!
 - Mikrokontroller = 20g...
- Kjapp!
 - Mikrokontroller = kjapp nok...
- Kompilering av FPGA... ☹



Hvorfor LabVIEW & sbRIO?

- Utstyr
 - Kamera, protokoller, ekspansjonsmuligheter
- Én stor platform
 - Simulering, testing, implementering

Utvikling!



Oppsummering

- Komplette løsning
 - Simulering
 - Testing
 - Implementering
- Lett å implementere
- Bra hardware
- Kan lett utvides

