Standard Configuration – raw signal through rotary joint

Required signal transmission
- **USB camera**
- **2x optical sensor (7 lines, 5(?) signal, 2 power,) OR 2x USB mouse**
- **2x lick port**
- **2x reward delivery**
- **1x GND**
- **Separate commutator for ephys (can be above or below stage)**

Harp configuration
- **Optical sensor integration x2 (optional with USB mouse)**
- **Lick port signal**
- **Reward signal output**

Rotary joint requirements
- **19 signal / power lines, 1 USB – OR (flow sensor)**
  - **+12V, +5V, GND**
- **5 signal / power lines, 3 USB (gaming mouse)**
  - **+12V, +5V, GND**
- **Through hole for air**

Pros
- **Minimal electrical components on board rotary platform**
- **Least additional testing / development required**
- **Simple signal transmission**
- **Existing off-the-shelf rotary joints with through-hole available**
- **Power on board rotary platform not required**

Cons
- **A lot of separate lines being passed through rotary joint (though check how many lines can be shared between flow sensors, e.g. CLK)**
- **Concerns about reliability of USB signal transmission**
- **Might require new rotary joint to scale up signal transmission**
- **Concerns about I2C protocol being reliably read through rotary joint (for optical flow sensor), issue with long wires.**
- **Concern about power stability over rotary joint, regulator on platform side?**

On rotary platform

HARP (Slave)

Hall effect sensor

HARP (Master)

Incremental encoder
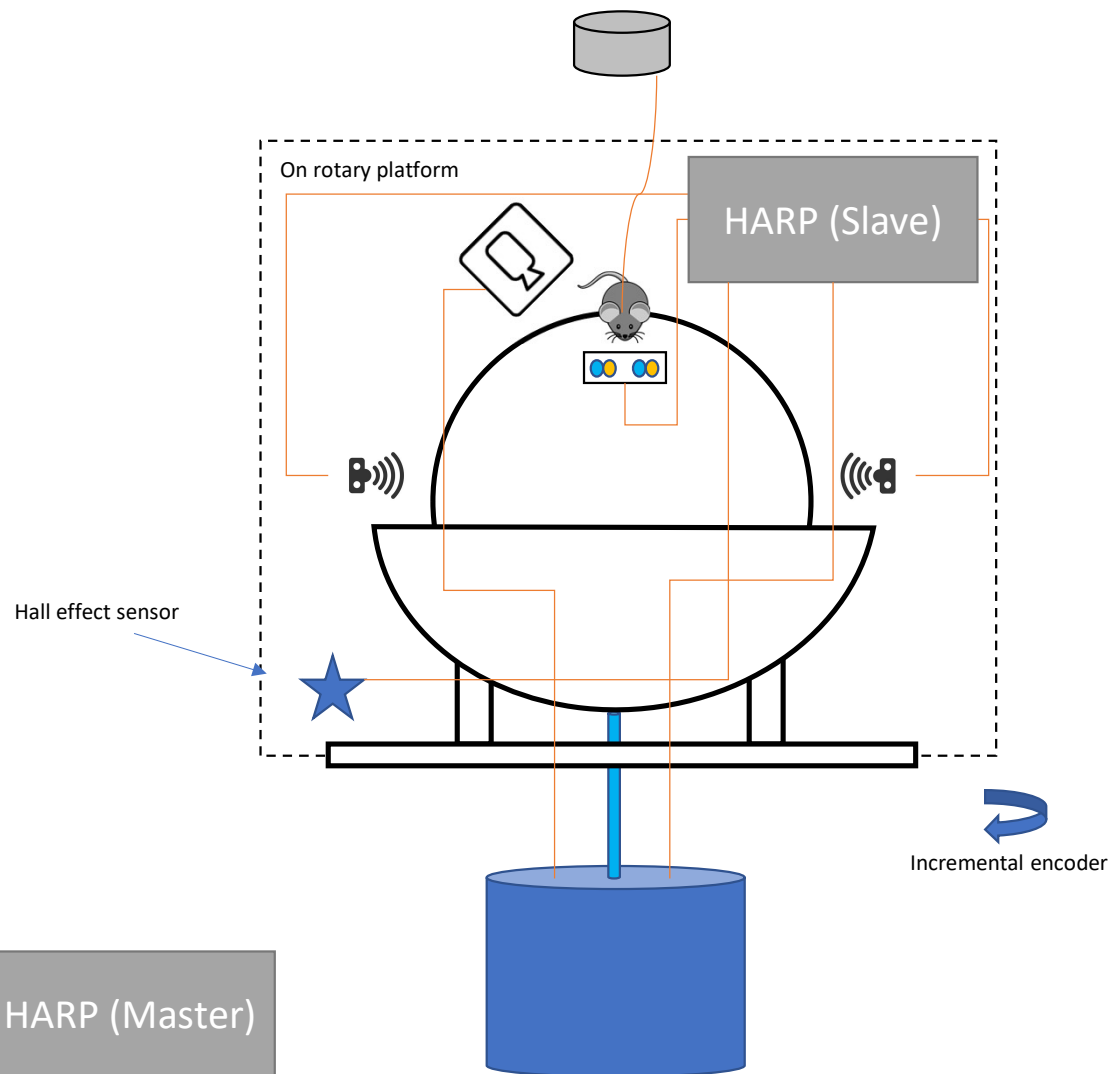
Standard Configuration – signal processed on board harp device

Required signal transmission
- **USB camera**
- **2x optical sensor (7 lines) OR 2x USB mouse**
- **2x lick port**
- **2x reward delivery**
- **1x GND**
- **Separate commutator for ephys (can be above or below stage)**
- **Synchronisation signal between two harp boards**

Harp configuration
- **Optical sensor integration x2 (optional with USB mouse)**
- **Lick port signal**
- **Reward signal output**

Rotary joint requirements
- **2 USB, through hole**
- **Optional 4 power lines e.g. for valve power**

Pros
- **Also minimal additional testing / development**
- **Readily available rotary joint with through-hole**
- **Simplification of signals leaving platform via rotary joint**
- **Easy to scale up signals leaving platform since integrated on board harp, limited only by USB bandwidth**

Cons
- **Extra electrical component on rotary platform, close to ephys, extra weight**
- **Cannot power valves through harp USB. Solution could be to use hybrid joint with 4 power lines, or use battery pack for valve power**
- **Concerns about reliability of USB transmission via rotary joint**
- **Would need a separate device outside rotary platform to integrate incremental encoder and hall effect sensors**
- **HARP signals must leave platform via USB, can't interface directly with motor driver (without hybrid rotary joint)**
- **Incremental encoder cannot be on rotary platform, so at least 1 USB signal must pass through rotary joint**
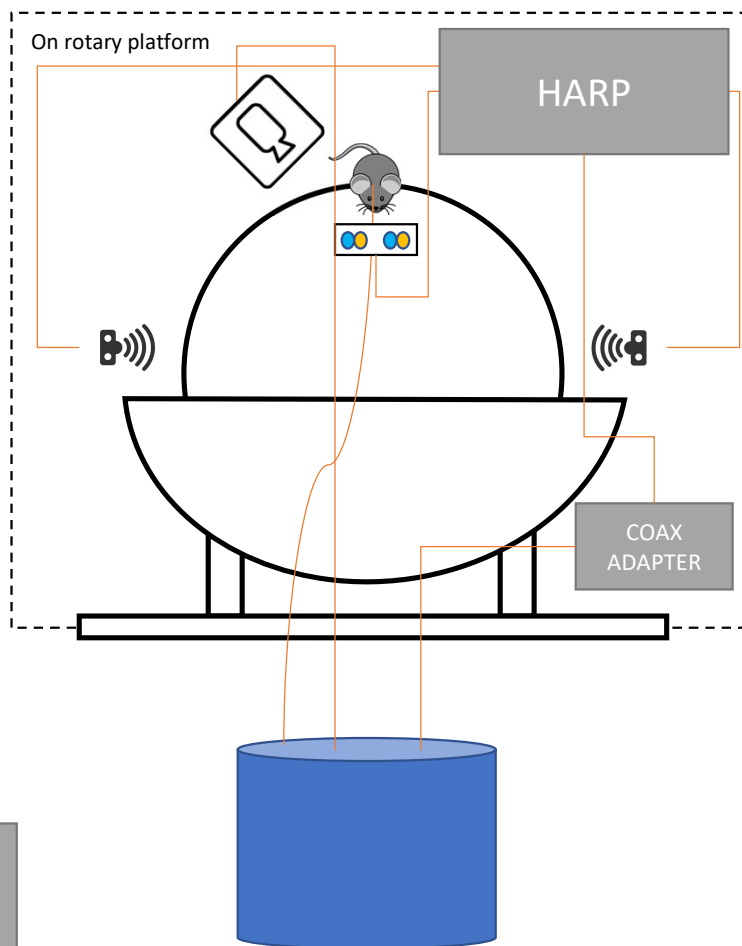
ONIX Adapter configuration

Required signal transmission
- **USB camera**
- **2x optical sensor (7 lines) OR 2x USB mouse**
- **2x lick port**
- **2x reward delivery**
- **1x GND**
- **Ephys**

Harp configuration
- **Optical sensor integration x2 (optional with USB mouse)**
- **Lick port signal**
- **Reward signal output**
- **Camera**
- **Adapter USB -- > COAX, communication with ONIX Hub**

Rotary joint requirements
- **2-3 Coax**

Pros
- **No hybrid rotary joints needed, use 2-3Ch high frequency RF coax**
- **Easy to scale up signals leaving the platform, limited by USB→coax bandwidth**
- **More reliable signal transmission through RF coax (vs. USB)**

Cons
- **HARP likely has to be on board rotary platform, hybrid coax USB not readily available**
- **Similarly, camera communication not as trivial as can't use USB.**
- **Coax rotary joints tend to not have through hole, might require custom development.**
- **Significant development required to develop appropriate Harp → ONIX communication.**
- **If coax through hole rotary joint not available need a different solution for floating treadmill (e.g. bowl ball bearings)**
- **Would need a separate device outside rotary platform to integrate incremental encoder and hall effect sensors**
- **More dependent on custom designs vs. off-the-shelf components**
- **HARP signals must leave platform via USB, can't interface directly with motor driver (without hybrid rotary joint)**