HAPTICS IN COCKPIT ENVIRONMENT (HYPSTAIR project – haptic interfaces)

Symposium E^2- Fliegen

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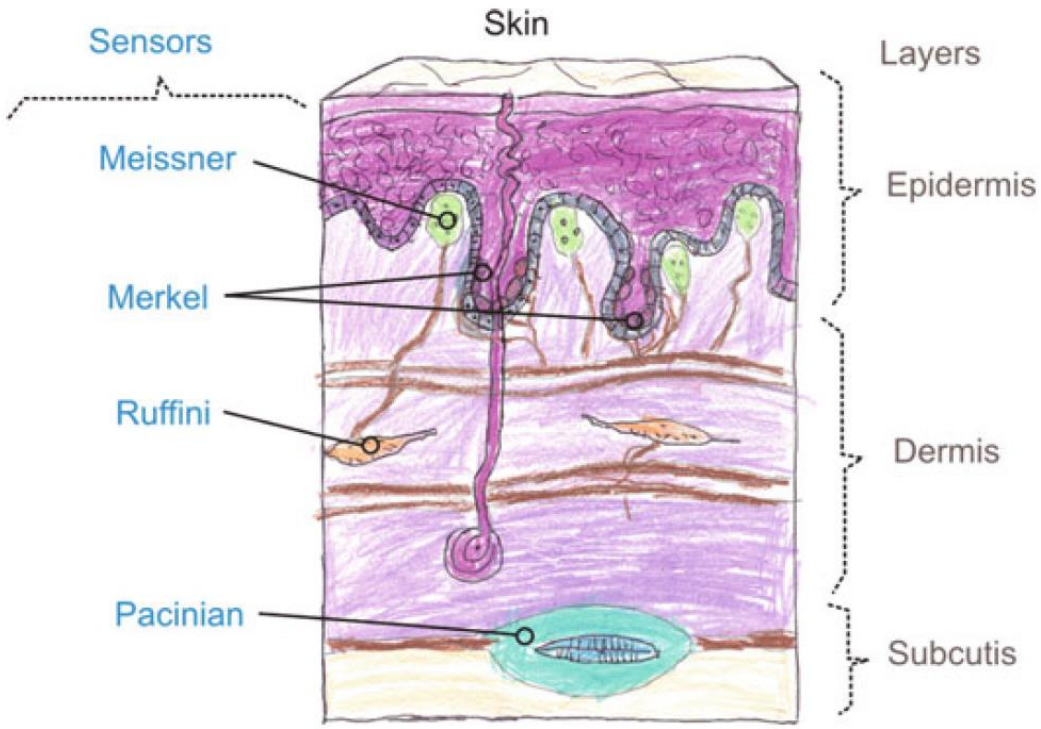
Haptics

TACTILE

Mechanoreceptors in skin:

- Meissner's corpuscles
- Pacinian corpuscles
- Merkel's disks
- Ruffini endings

Feeling pressure, texture, vibrations

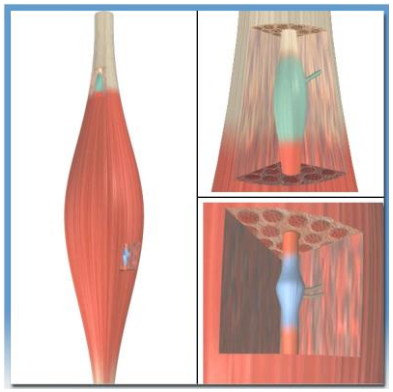


Source: Haptics technologies

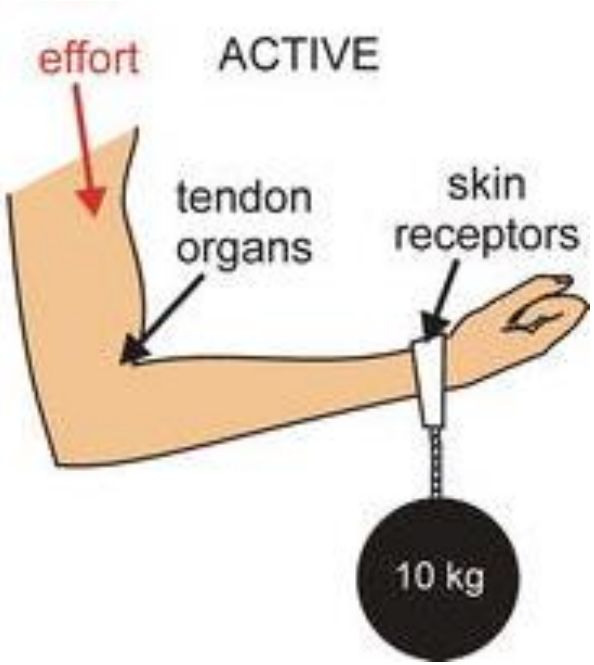
Haptics

KINESTHETIC

- Mechanoreceptors in joints and muscles
- Feeling body motion, position&orientation, forces
- Manipulation



Source: www

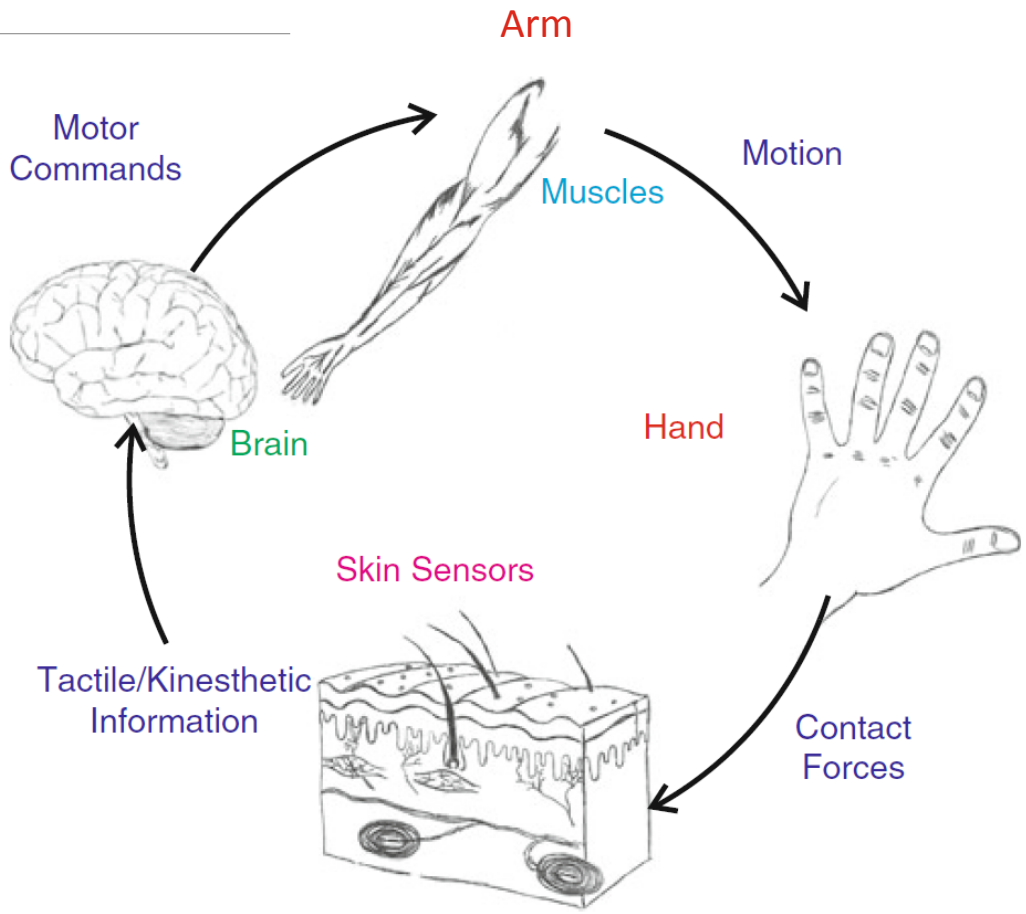


Haptics

Human haptic system consists of:

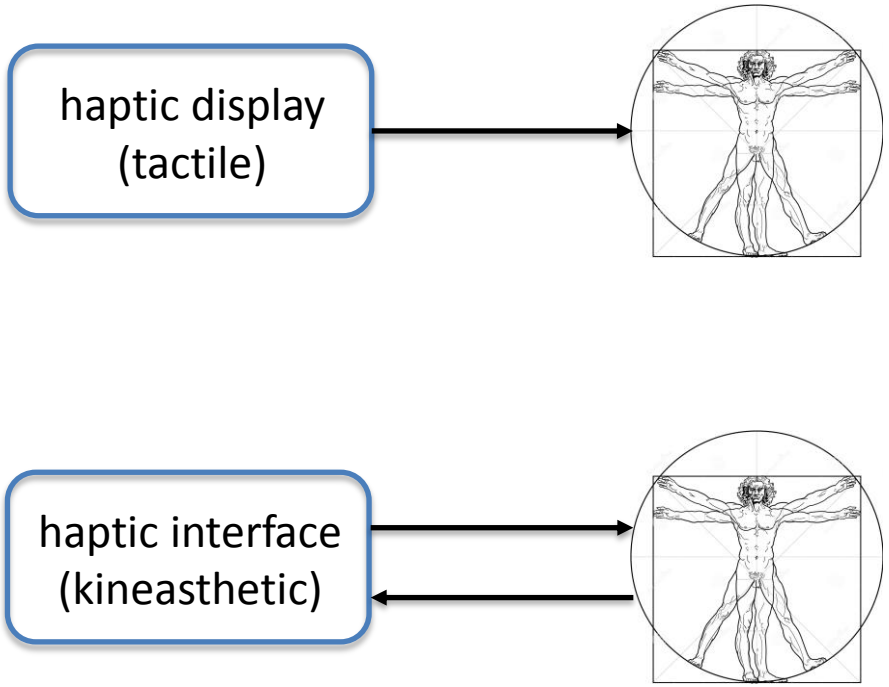
- mechanical
- sensory
- *motor*
- *cognitive*

components.

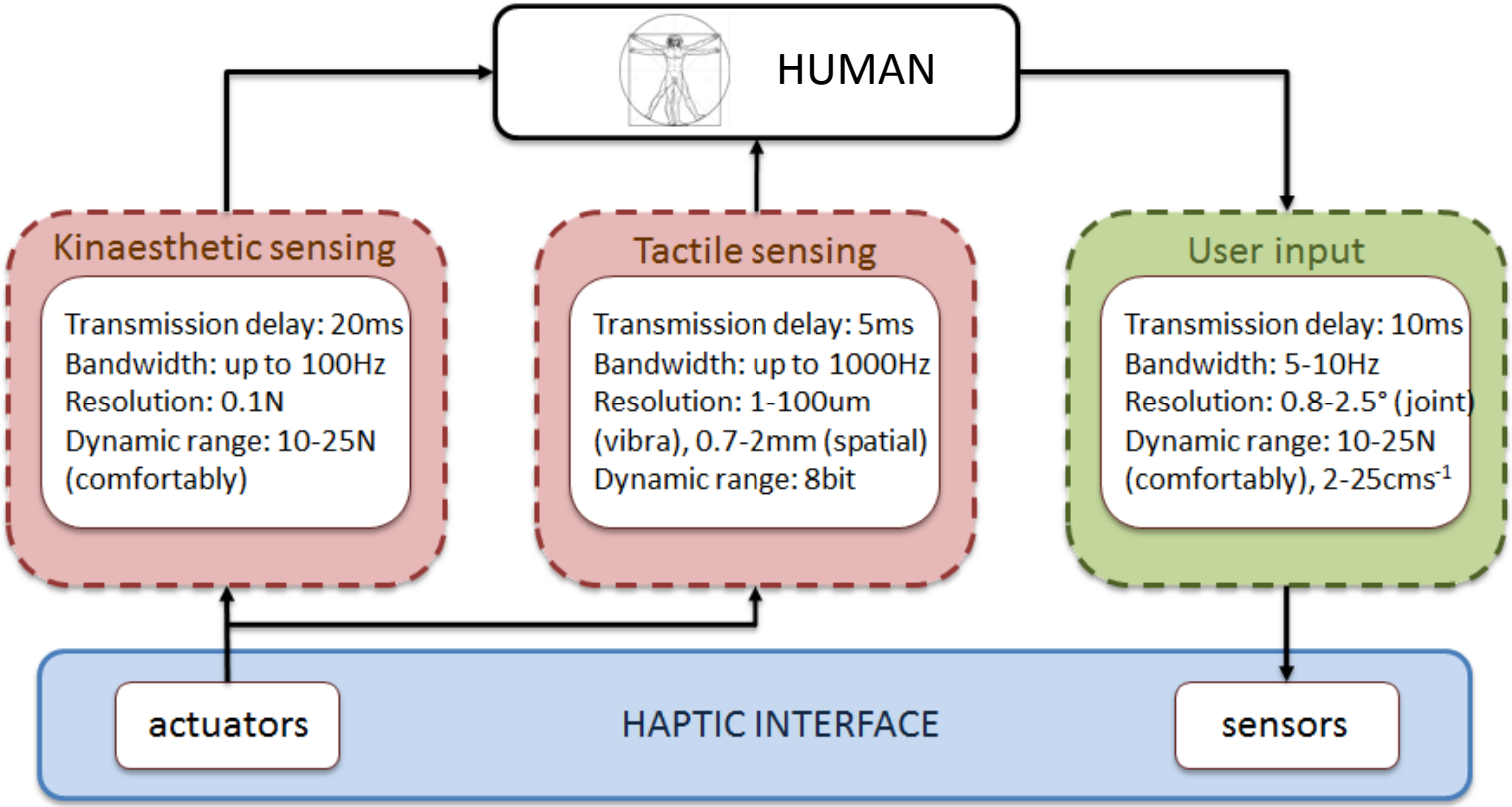


Source: Haptics technologies

Haptic interfaces



Haptic interfaces



Source: adapted from Engineering Haptic Devices

Haptic interfaces in vehicles

- Human perception must be considered in the design of a vehicle cockpit.
- Haptic sense enables different control operations without visual attention.
- Cockpit can be simplified and enhanced by intuitive feel.

Source: Audi World

Haptic interfaces in vehicles

Lexus, BMW, Mercedes: haptic control knob

Cadillac: haptic display

Source: www

Haptic interfaces in aircrafts

aircraft cockpit with control wheel/yoke

turn left

straight & level

turn right

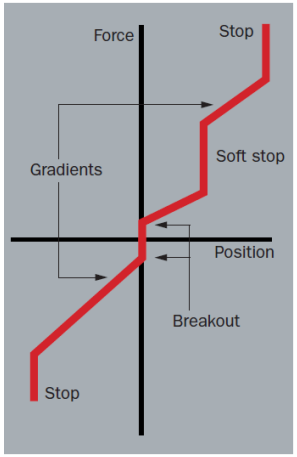
aircraft cockpit with control side sticks

Source: www

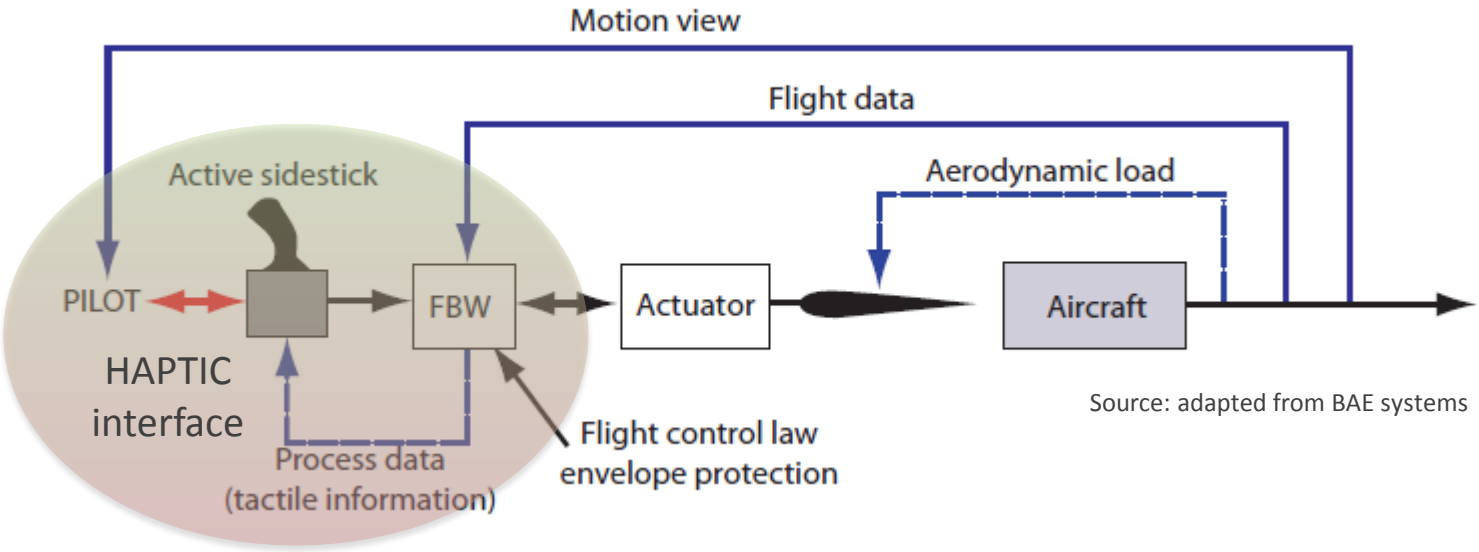
side sticks

Haptic interfaces in aircrafts

Fly-by-wire



Programmable force profile



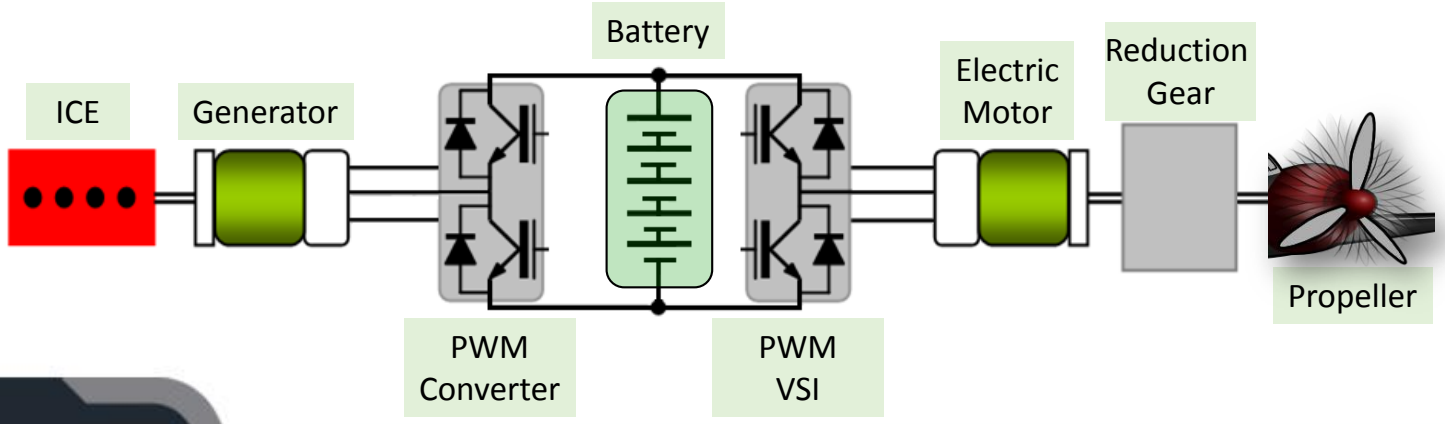
Source: adapted from BAE systems

Active sidestick

- tactile cues carry information, and
- reduce pilot workload

HYPSTAIR project

ELECTRIC MOTOR DRIVES PROPELLER



HYPSTAIR project

PIPISTREL

Primary flight display
Navigation display
Engine indicating display
Flight controls
Throttle

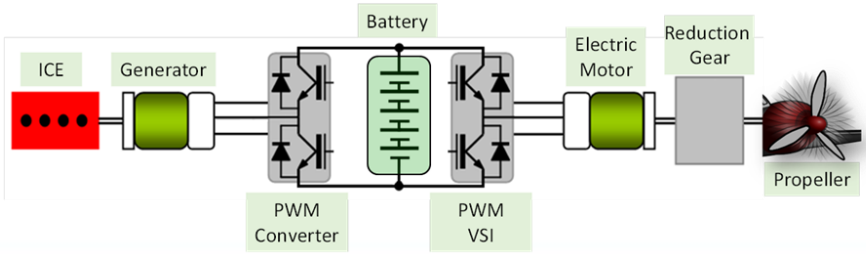
standard implementation of the cockpit

Haptic power lever

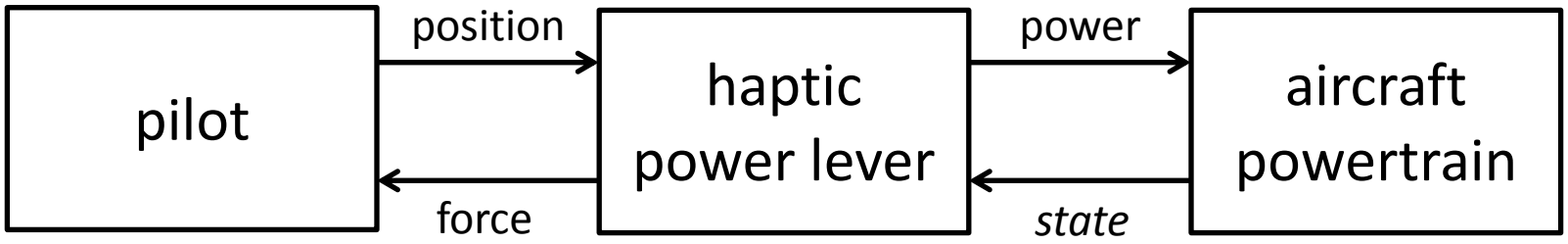
Haptic power lever should promote *efficient use of energy*, enhance level of *safety*, provide *intuitive control* of complex powertrain system, and to:

- increase pilot's awareness of batteries use.
- warn pilot about system failures.

power control ⇕ force feedback



Haptic power lever



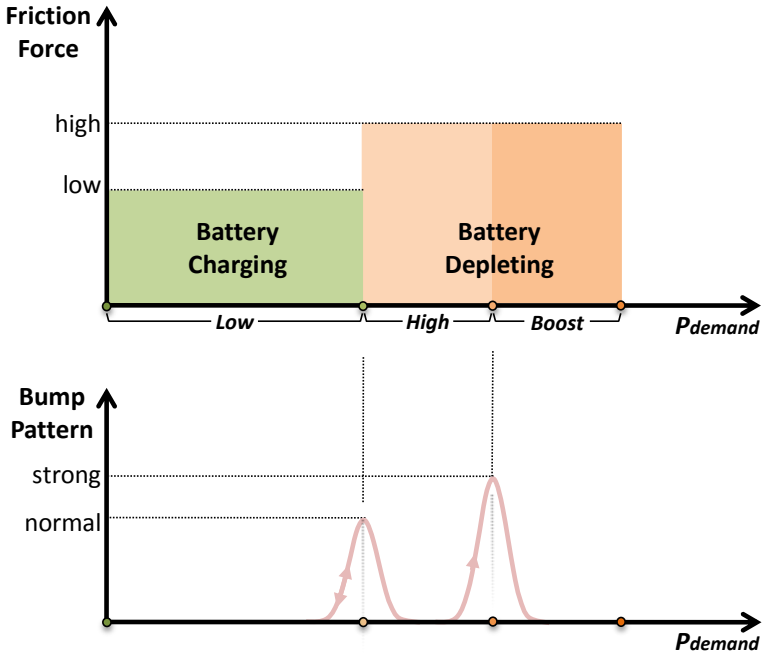
basic system block diagram

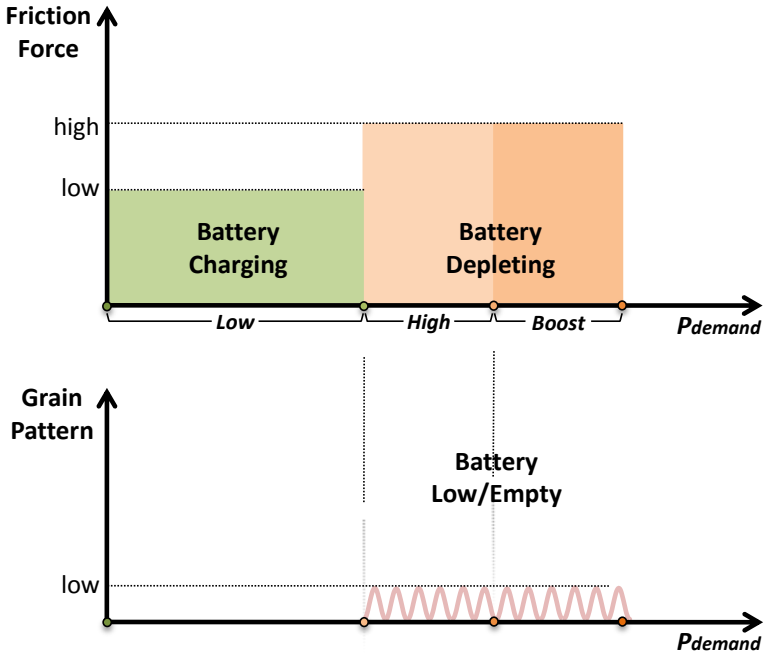
Haptic cues

Haptic power lever should provide relevant reliable information of the Aircraft Hybrid Powertrain System such as:

- power demand (LOW, HIGH), power available ?
- battery status (charging, depleting, low, empty)
- system failures (e-motor, ICE, battery, high temp.)

Haptic cues





diagrams of haptic cues

EXPERIMENTAL PROTOTYPE SYSTEM
Haptic power lever

Conclusions

- The haptic controls in cockpit improve safety and performance.
- Pilot workload can be reduced by simplified and intuitive HMI.
- More efficient use of energy in hybrid aircraft can be possible.
- Future incorporation of other haptic cues is also possible.