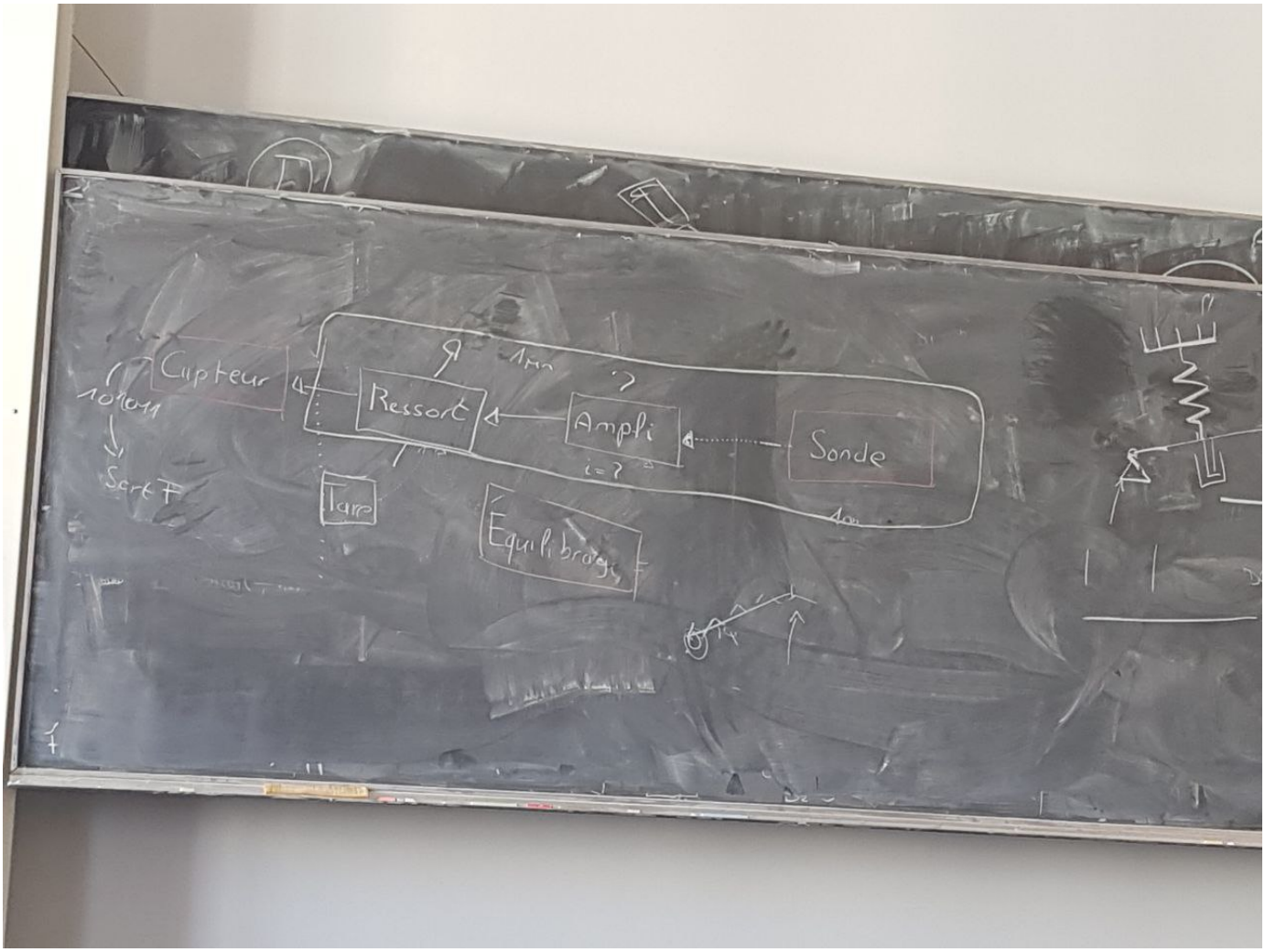
Projet

rigidité variable
force sensors
insenicble a la graité ???

- Gravity insensitive flexure pivots for watch oscillators
  https://infoscience.epfl.ch/record/222491
  https://asmedigitalcollection.asme.org/mechanicaldesign/article/140/7/075002/368997/Gravity-Insensitive-Flexure-Pivot-Oscillators
- Load cell with adjustable stiffness based on a preloaded T-shaped flexure pivot
  https://infoscience.epfl.ch/record/286918
- Variable-negative-stiffness-actuation base on buckling of beam
  https://www.semanticscholar.org/paper/VnSA%3A-Variable-negative-stiffness-actuation-based-Yalcin-Uzunoglu/ee90c1998e817587e8defb370ae885c285452f07
- Imina site web
  https://imina.ch/en
- design actuartor spring variable stiffness
  https://www.youtube.com/watch?v=eH3ZUsILZY0

Innitial Designs

Architecture Framework



- Sensor
- Actuator for stiffness contron
- Actuator for 0 Force setting
- Variable Spring
- Amplification and mouvemnt conversion
- Probe

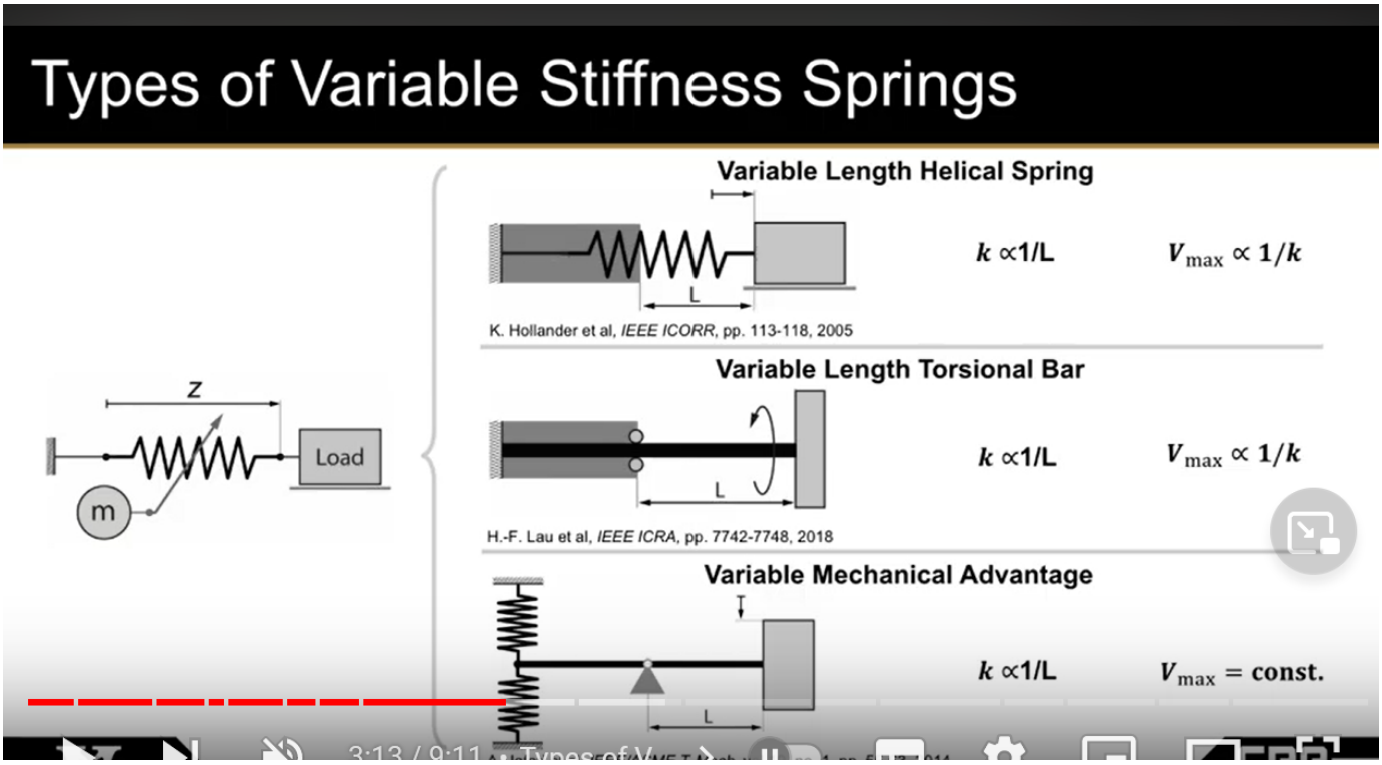
Sensor

sensors is fixed,
resolution and dynamic range are known.
we sense displacement, can be spring but depend of actutor position to convert back to force and greater range
can be absolute but reduce real dynamic range

Actuator

motor that turn a screw, pitch of nut and screw determine precision of linear motion, beware of backlash.

Variable Spring



two family of approach :

1. classic spring design
2. buckling beam

classic spring design -> reduce effective lenght of spring

- poor dynamic range
- less compact

classic spring design -> torsion spring with mobile pivot

- require torsion thus linear conversion as :
  mouvmenet vertical et pas rotationnel car sinon déviation sonde de :

$$28mm - cos(arcsin(\frac{0.5[mm]}{28[mm]})) * 28[mm] = 4.5micron$$

DONC TROP DE DÉVIATION EN X -> mouvement vertical seulement.

classic spring design -> cantilver with mobile pivot

- better dynamic range ?
- linear or not ?

buckling beam

- linear or not ?
- better dynamic range ?

Amplification and mouvemnt conversion

possible amplification ? improve dynamic range ?

possibly need mouvment conversion depending on choosen spring desing

Probe

need to move vertically. no rotation due to x projection error :
déviation sonde de :

$$28mm - cos(arcsin(\frac{0.5[mm]}{28[mm]})) * 28[mm] = 4.5micron$$

DONC TROP DE DÉVIATION EN X -> mouvement vertical seulement.

Comparison matrix of each design

Choosen configuration

the best configuration is :

Advantage

limitation

Flex conversion

easy from classical design.
grubler and stuff.

gravity insensitivity

must equilibrate design