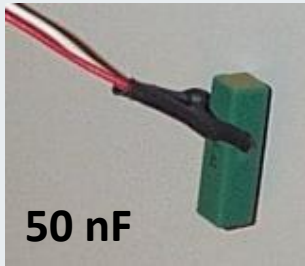
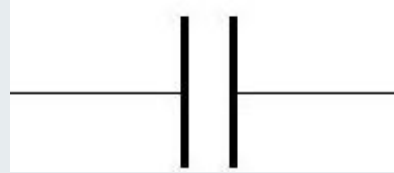




qbio
quantitative
biology

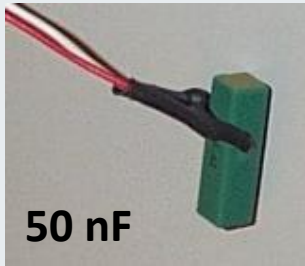
Capacitor/capacitance: electronic device used to store electrical energy in the form of charges

$$C[F] = \frac{Q [C]}{\Delta V [Volts]}$$



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$$C[F] = \frac{Q [C]}{\Delta V [Volts]}$$



Batteries
[Ampere x hour]

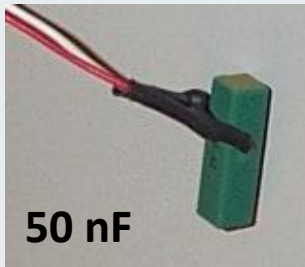
2600 mAh

Chemical storage



Capacitor/capacitance: electronic device used to store electrical energy in the form of charges

$$C[F] = \frac{Q [C]}{\Delta V [Volts]}$$



Chemical storage

Batteries
[Ampere x hour]

2600 mAh



50 Ah



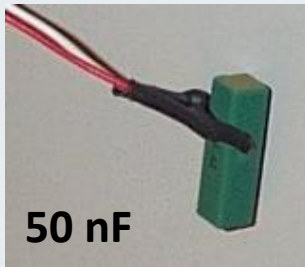
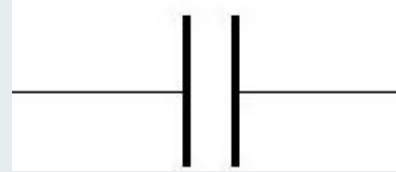
Resistor/resistance: electronic device used to resist or block the flow of current in a circuit

$$R[\Omega] = \frac{\Delta V [Volts]}{i [Ampere]}$$



Capacitor/capacitance: electronic device used to store electrical energy in the form of charges

$$C[F] = \frac{Q [C]}{\Delta V [Volts]}$$

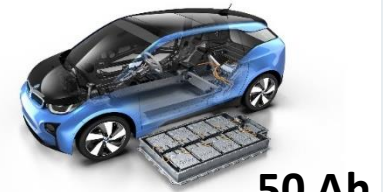


$$R[\Omega] = \frac{\Delta V [Volts]}{i [Ampere]}$$

Batteries
[Ampere x hour]

Chemical storage

2600 mAh



50 Ah

Resistor/resistance: electronic device used to resist or block the flow of current in a circuit

$$R[\Omega] = \frac{\Delta V [Volts]}{i [Ampere]}$$



$$P[W] = Vi[VA] = R i^2 \rightarrow P = 810 mW (heat)$$

[kWh]

[Joule]

[VA]

[Watt]



Power

Energy



Votre contrat Electricité



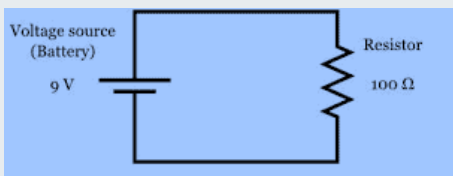
"Tarif Bleu" - 06 kVA - Option Heures Creuses - Compteur communicant n° [redacted]

Horaires heures creuses - 3H06-8H06 13H36-16H36 - (peuvent varier de quelques minutes)

			Prix €HT/mois	Montant €HT	TVA
Abonnement					
Heures Creuses - 06kVA - du 19/06/23 au 31/07/23			10,16	14,09	5,5%
Heures Creuses - 06kVA - du 01/08/23 au 19/08/23			10,55	6,47	5,5%
Heures Creuses - 06kVA - du 20/08/23 au 19/10/23			10,55	21,10	5,5%
Déduction - Heures Creuses - 06kVA - du 19/06/23 au 19/08/23			10,16	-20,32	5,5%
Total Abonnement (dont acheminement 15,16 €)				21,34	
	Relevé début	Relevé fin	Conso kWh	Prix €HT/kWh	Montant €HT
Consommation					
Heures Creuses - 06kVA - du 19/06/23 au 19/08/23	5684 (Enedis)	5795 (Enedis)	111	0,1373 ⁽¹⁾	15,24
Heures Pleines - 06kVA - du 19/06/23 au 19/08/23	5446 (Enedis)	5545 (Enedis)	99	0,1901 ⁽²⁾	18,82
Total Consommation (dont acheminement 2,31 €)				210	34,06
			Conso kWh	Prix €HT/ kWh	Montant €HT
Taxes et Contributions					
Contribution au Service Public d'Electricité (CSPE)			210	0,00100	0,21
Contribution Tarifaire d'Acheminement Electricité (CTA)					3,33
Total Taxes et Contributions					3,54
Total Electricité hors TVA					58,94

P

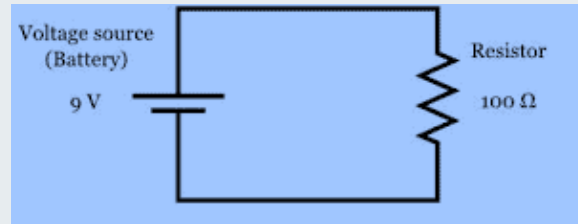
E

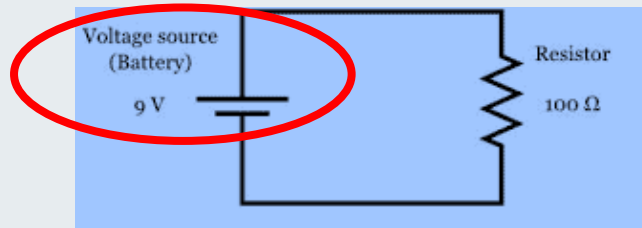


$$P[W] = Vi[VA] = R i^2 \rightarrow P = 810 \text{ mW (heat)}$$

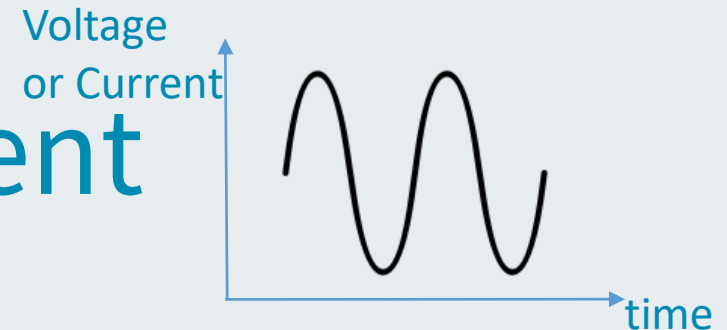
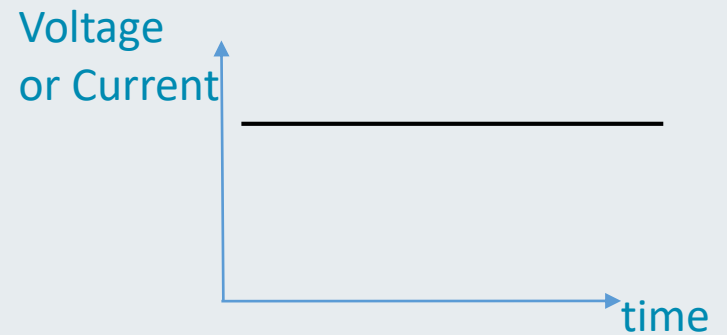
E = Energy [Joule] or [kWh] since $P [W] = E/t [J/s]$

An electrical circuit...





Voltage or Current source
It is called function generator

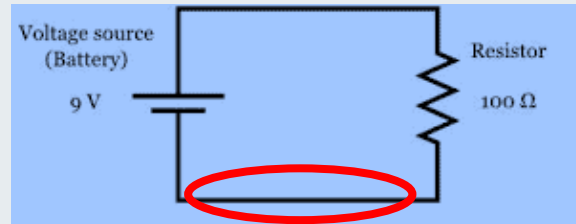


DC – direct current

AC – alternating current

Electric cables (coaxial cables)

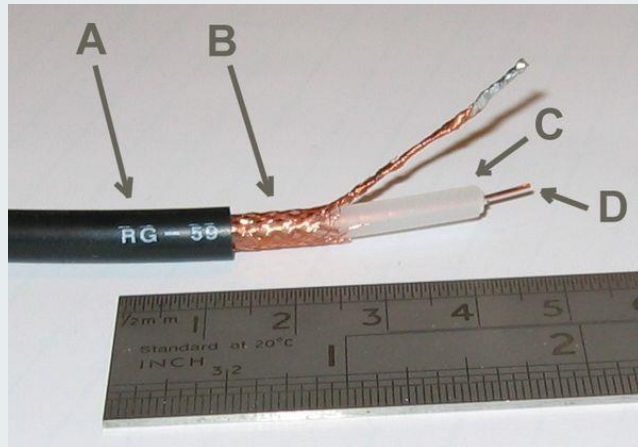
Carry high frequency signal
Low losses



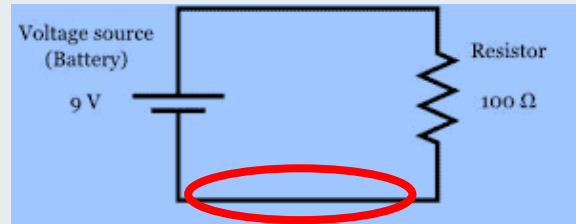
Velocity factor = speed in material/ speed in vacuum

$$V_F = \frac{1}{\sqrt{\epsilon}} \approx 60 - 90\%$$

$$\text{Cable delay} = \frac{L \times v_{\text{light}}}{V_F}$$



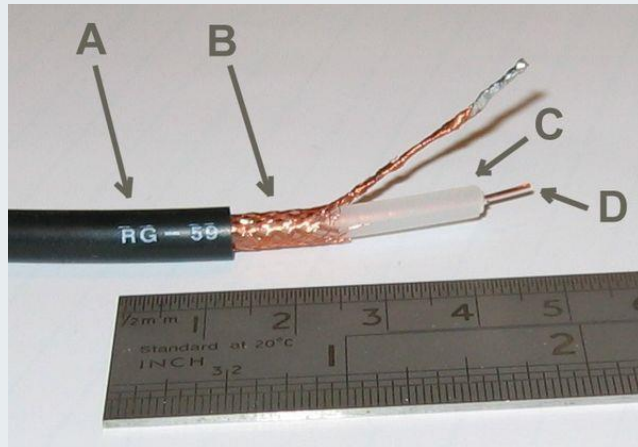
Electric cables (coaxial cables)



Velocity factor = speed in material/ speed in vacuum

$$V_F = \frac{1}{\sqrt{\epsilon}} \approx 60 - 90\%$$

$$\text{Cable delay} = \frac{L \times v_{\text{light}}}{V_F}$$



BNC connector
(Bayonet Neill–Concelman connector)



SMA connector (for RF applications)
MHz, GHz

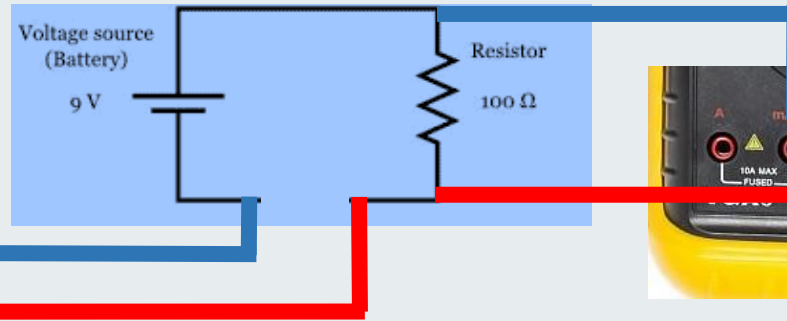


Decrease of resistive cable loss ¹¹

Readout – Multimeters and oscilloscope



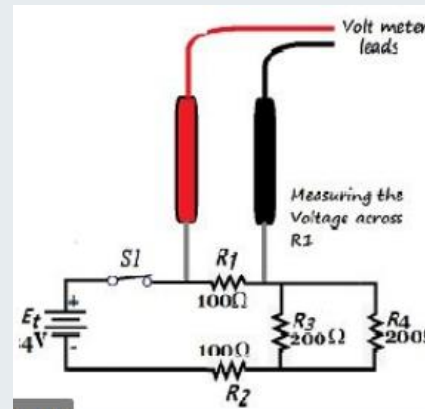
Current
Measurement (in series)



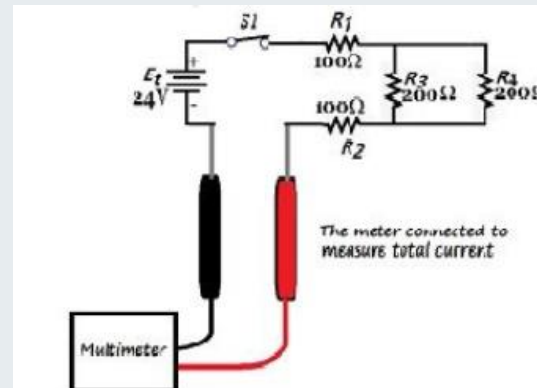
Voltage
Measurement
(In parallel)



Multimeter

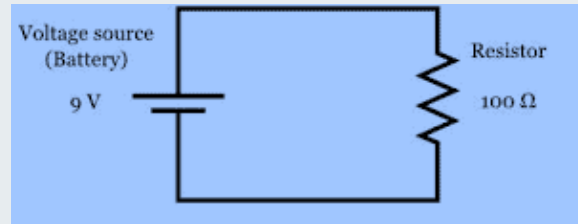


Voltage
Measurement
V in [Volts]



Current
Measurement
i in [Ampere]
[Ampere] = [C/sec]
 $e = 1.6 \times 10^{-19} \text{ C}$

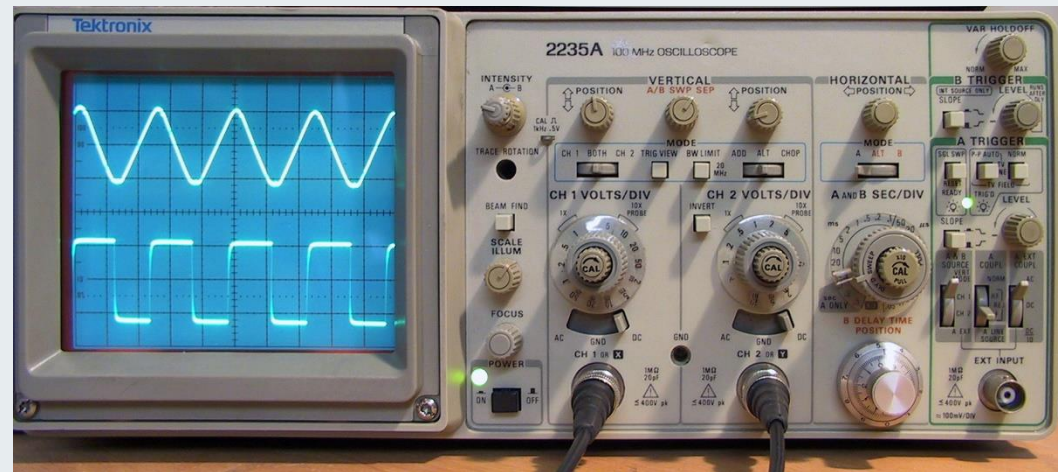
Readout – Multimeters and oscilloscope



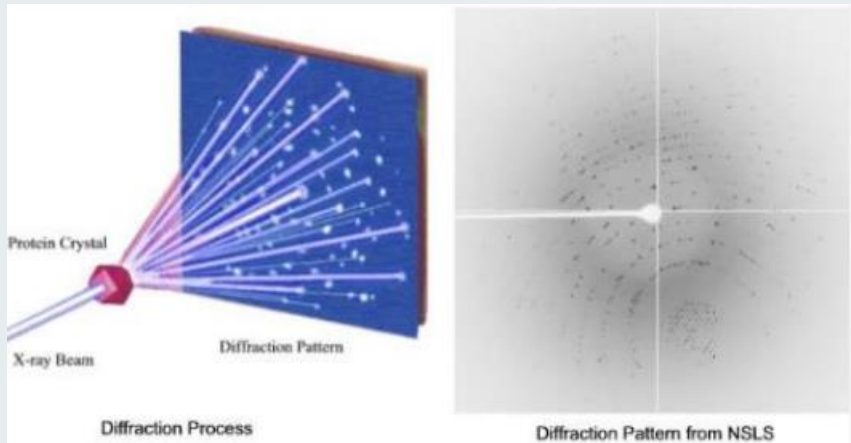
Voltage
measurement



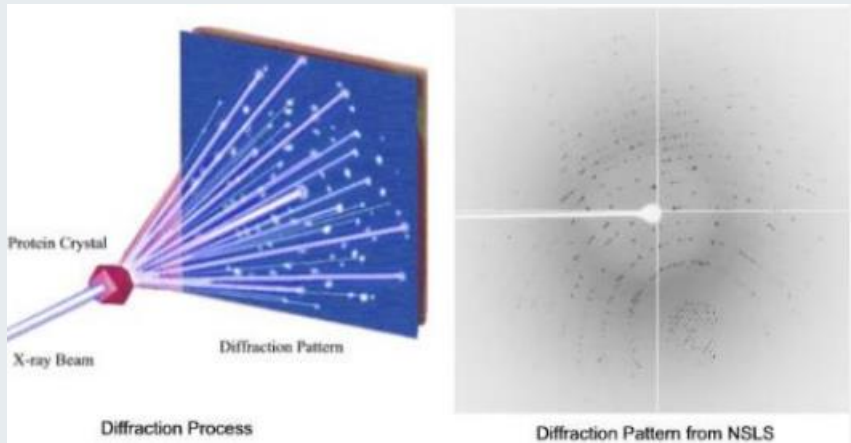
Multimeter



Oscilloscope



Real space \rightarrow wavenumbers space



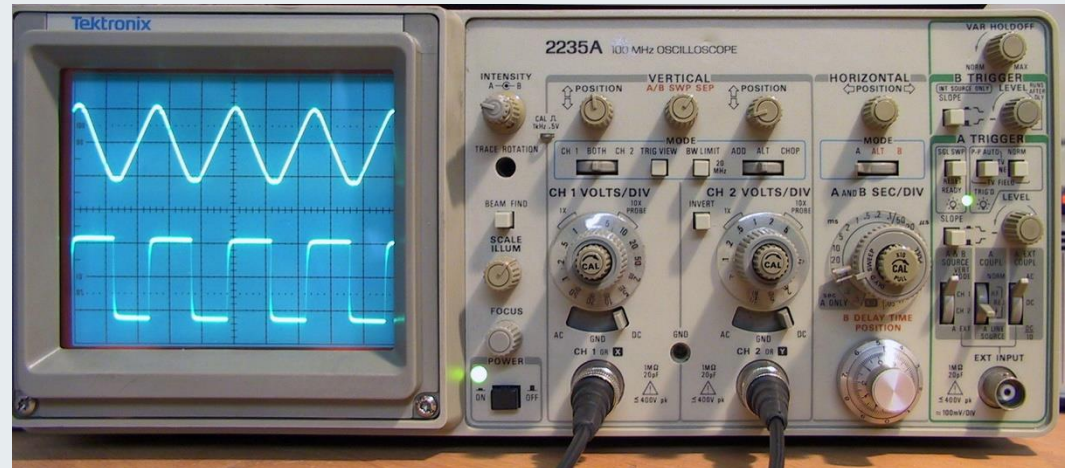
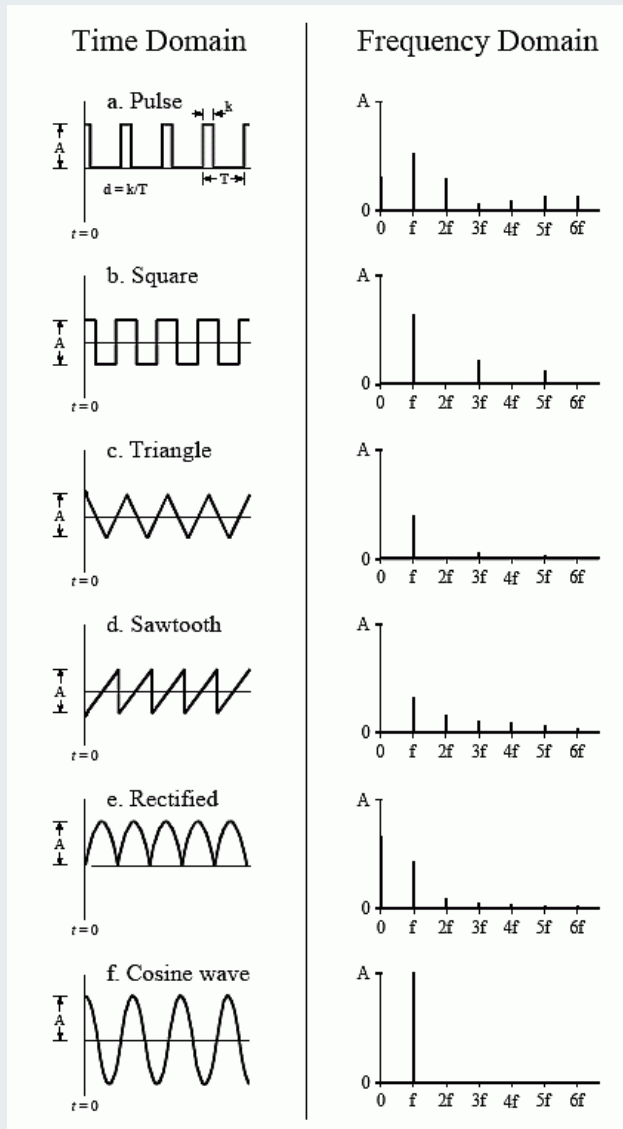
Real space \rightarrow wavenumbers space



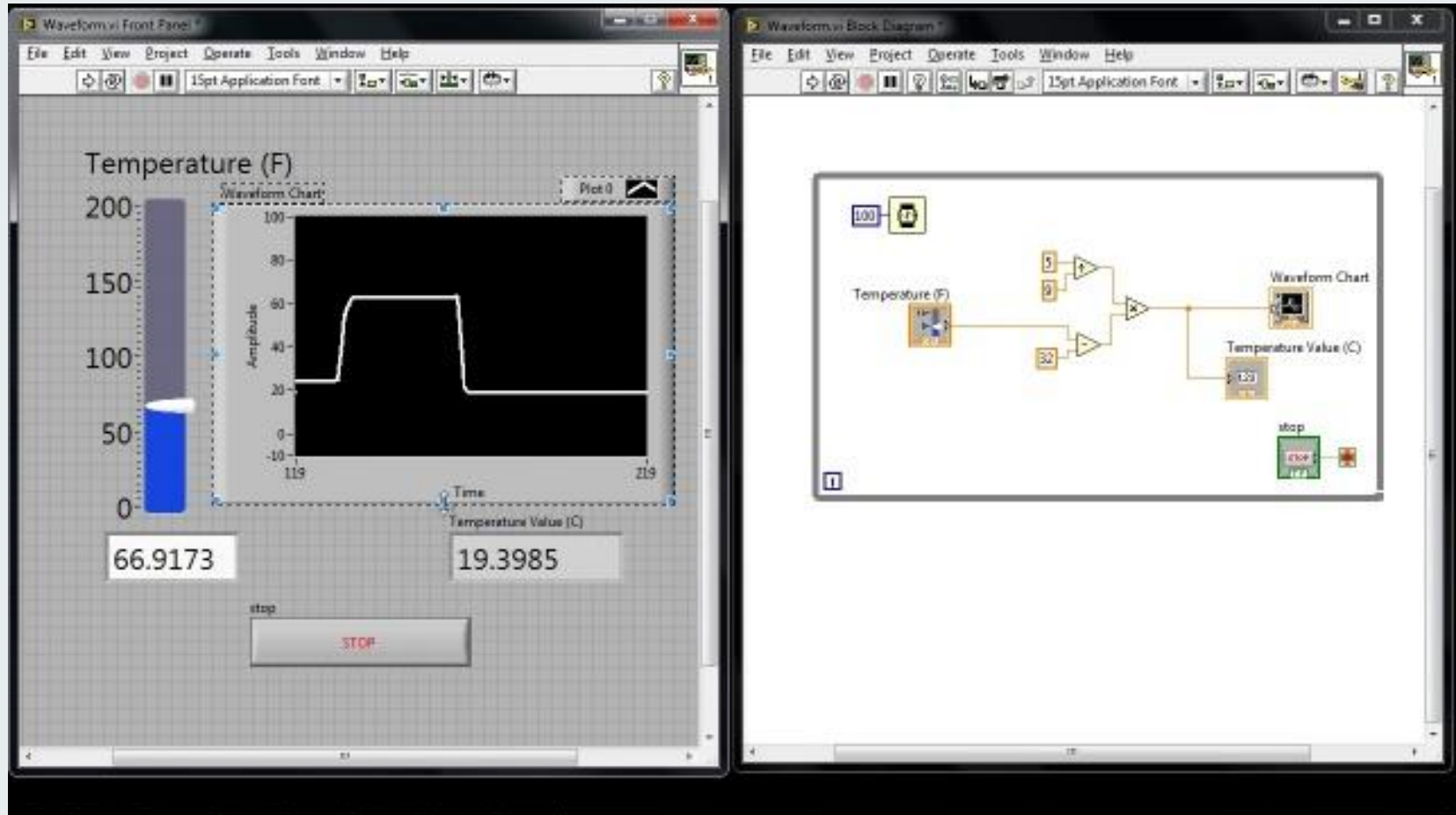
Pedal cadence, e.g. 50 per minute
Each pedal movement lasts for 1.2 s

Time \rightarrow Frequencies

Direct and reciprocal (Fourier) spaces



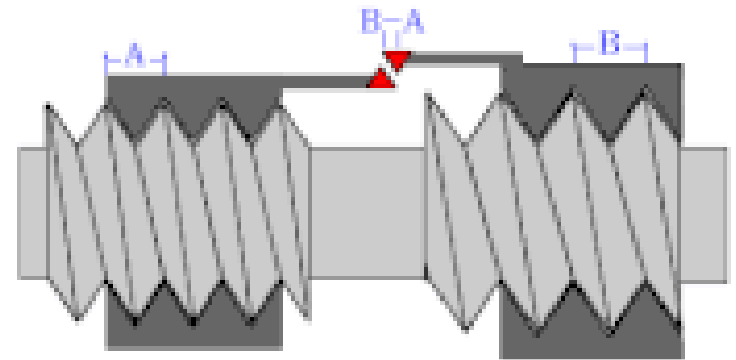
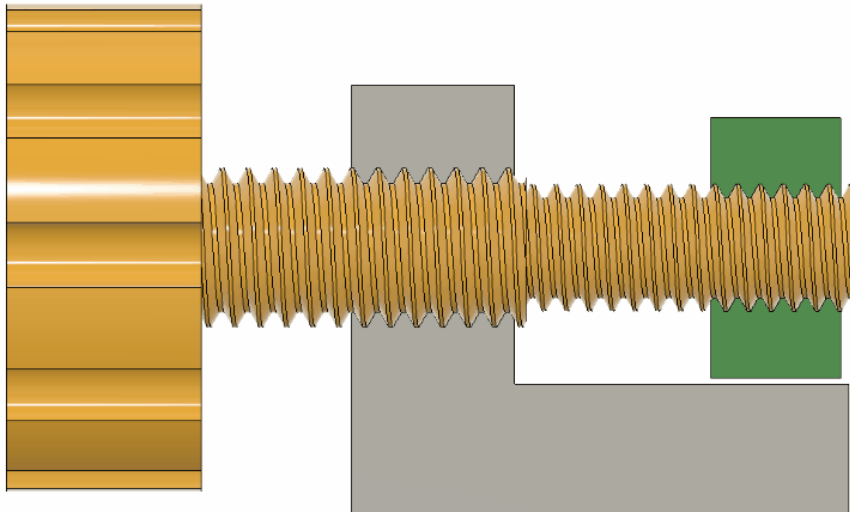




Micrometric screws
(differential screws)



eksmaoptics.com



[Wikipedia](https://en.wikipedia.org/wiki/Differential_screw)

Micrometric screws
(differential screws)



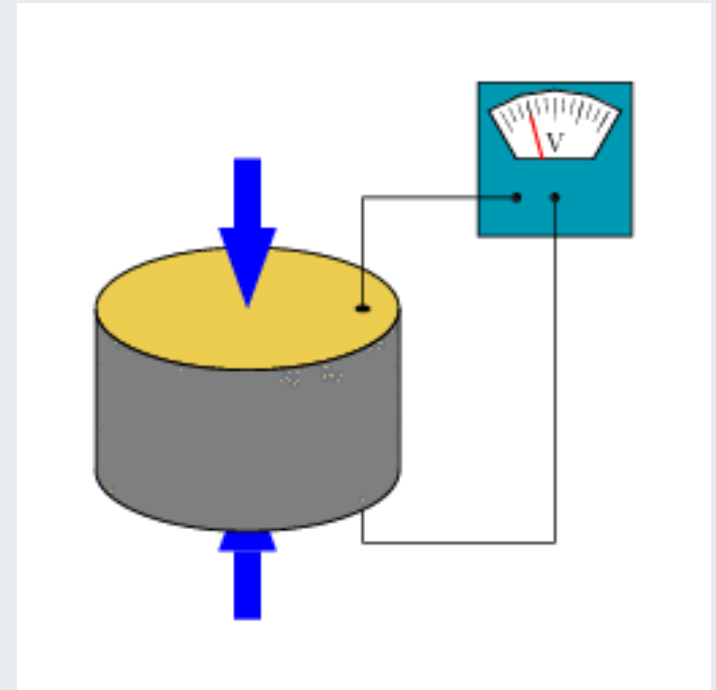
eksmaoptics.com

Piezoelectric elements



eksmaoptics.com

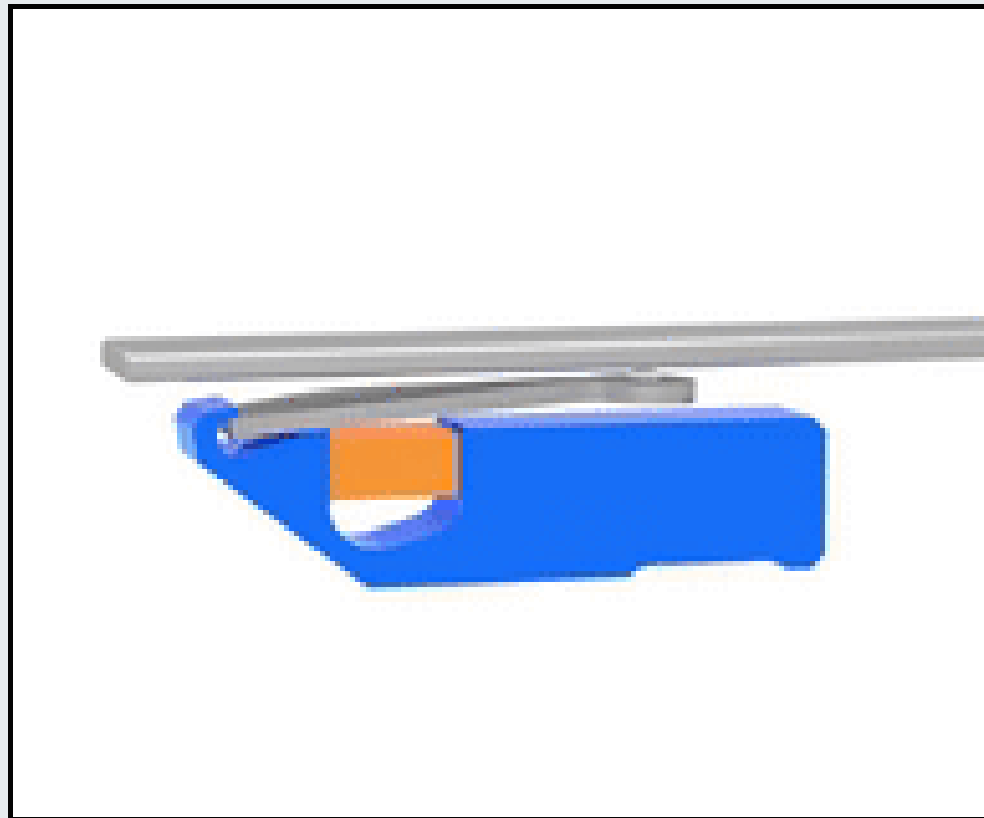
Problems:
Short displacement (<100 μm)
Hysteresis
Creep



Micrometric screws
(differential screws)



Inertial Motors

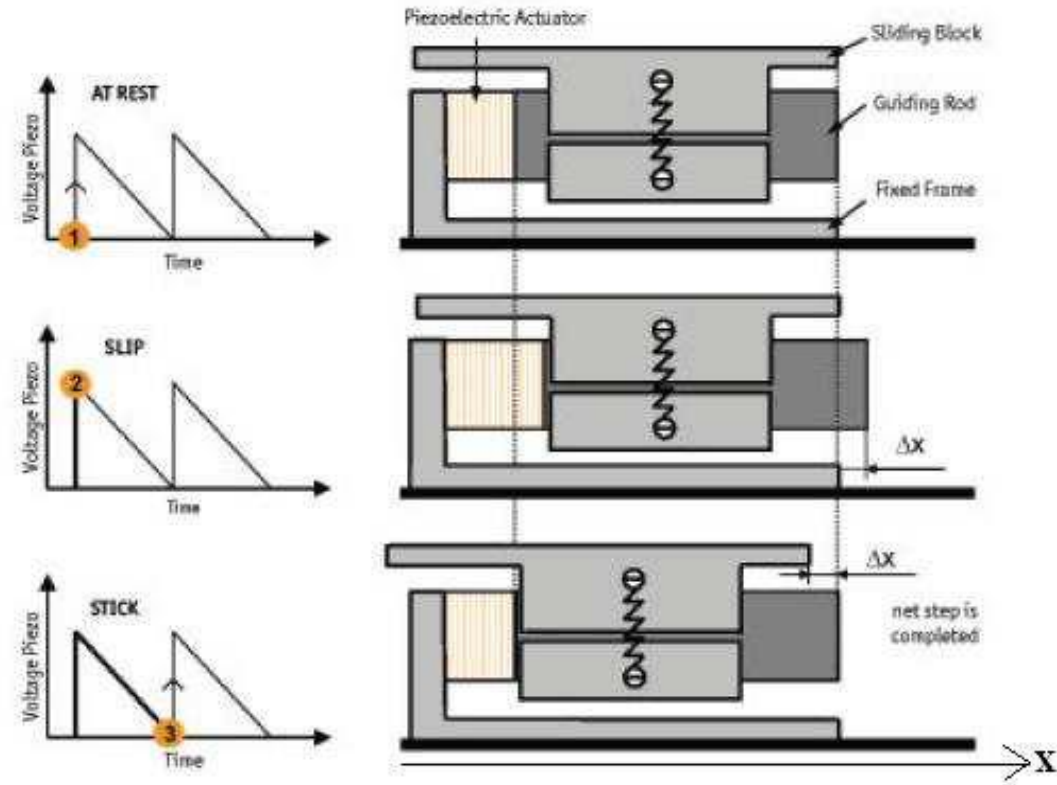


Translational stages

Micrometric screws (differential screws)



Inertial Motors



Luca Costa
luca.costa@cbs.cnrs.fr



Team Integrative Biophysics of Membranes (IBM)

<https://integrativebiophysicsofmembranes.wordpress.com/>

