Animation mécanisée de larynx humains excisés

Animaglotte

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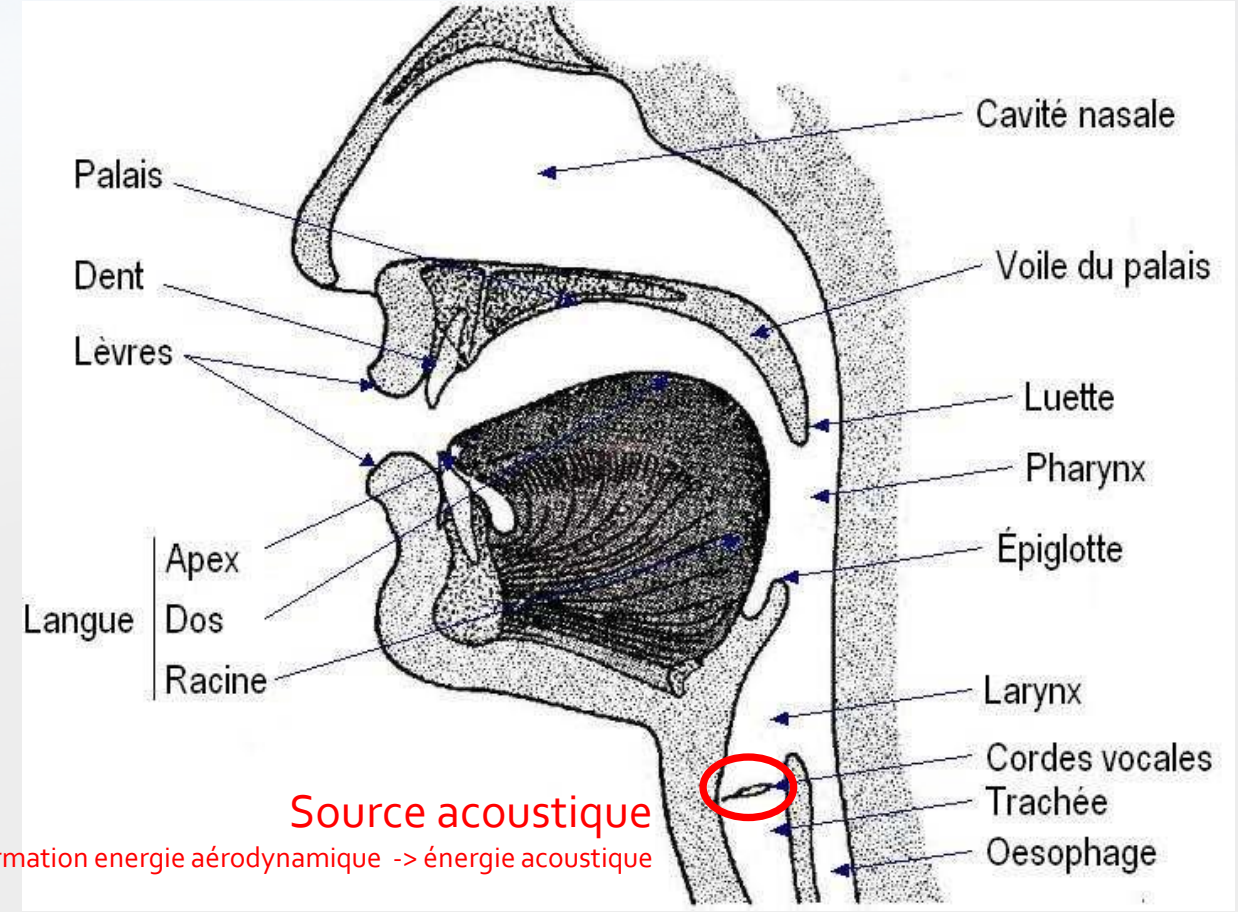
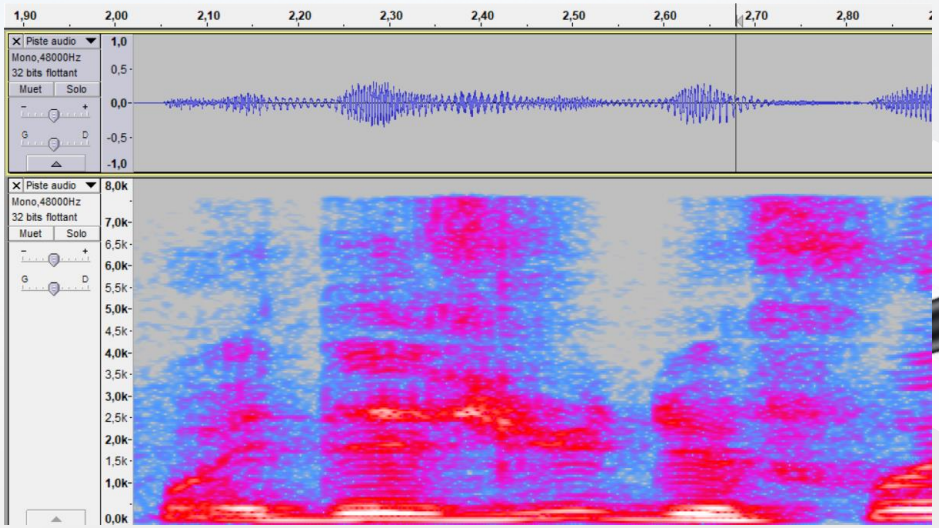
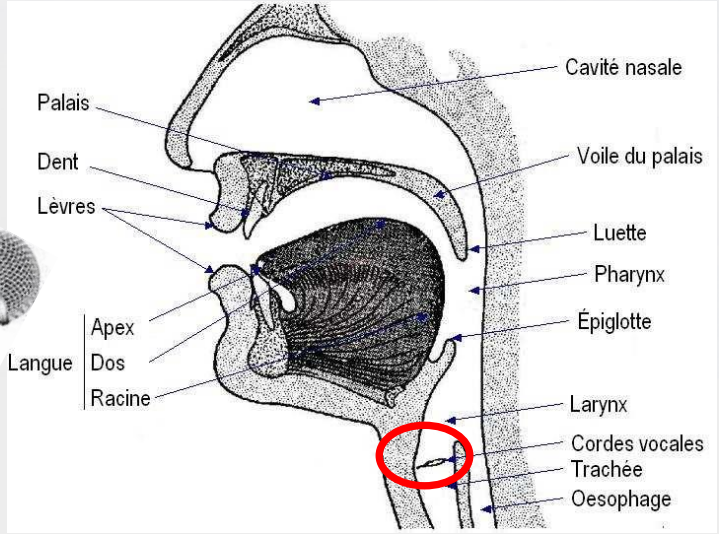
Le conduit vocal – aspects acoustiques



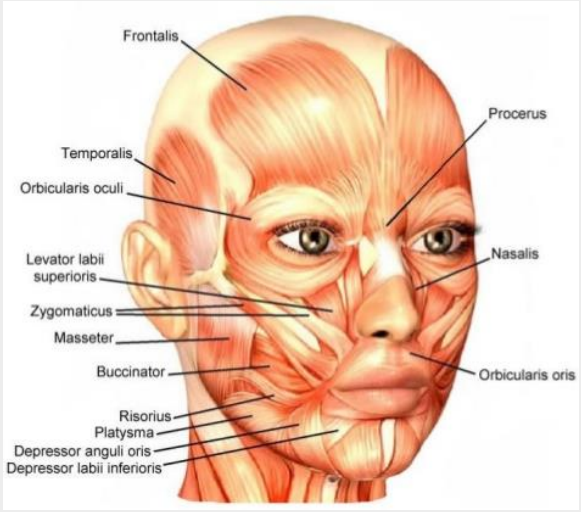
Transfrormation energie aérodynamique -> énergie acoustique

Le conduit vocal – aspects acoustiques



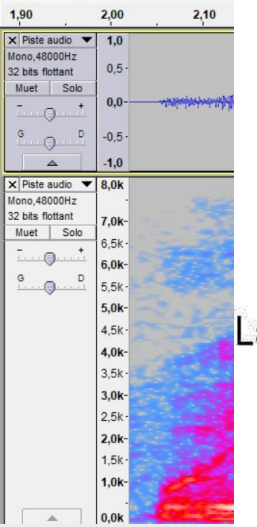


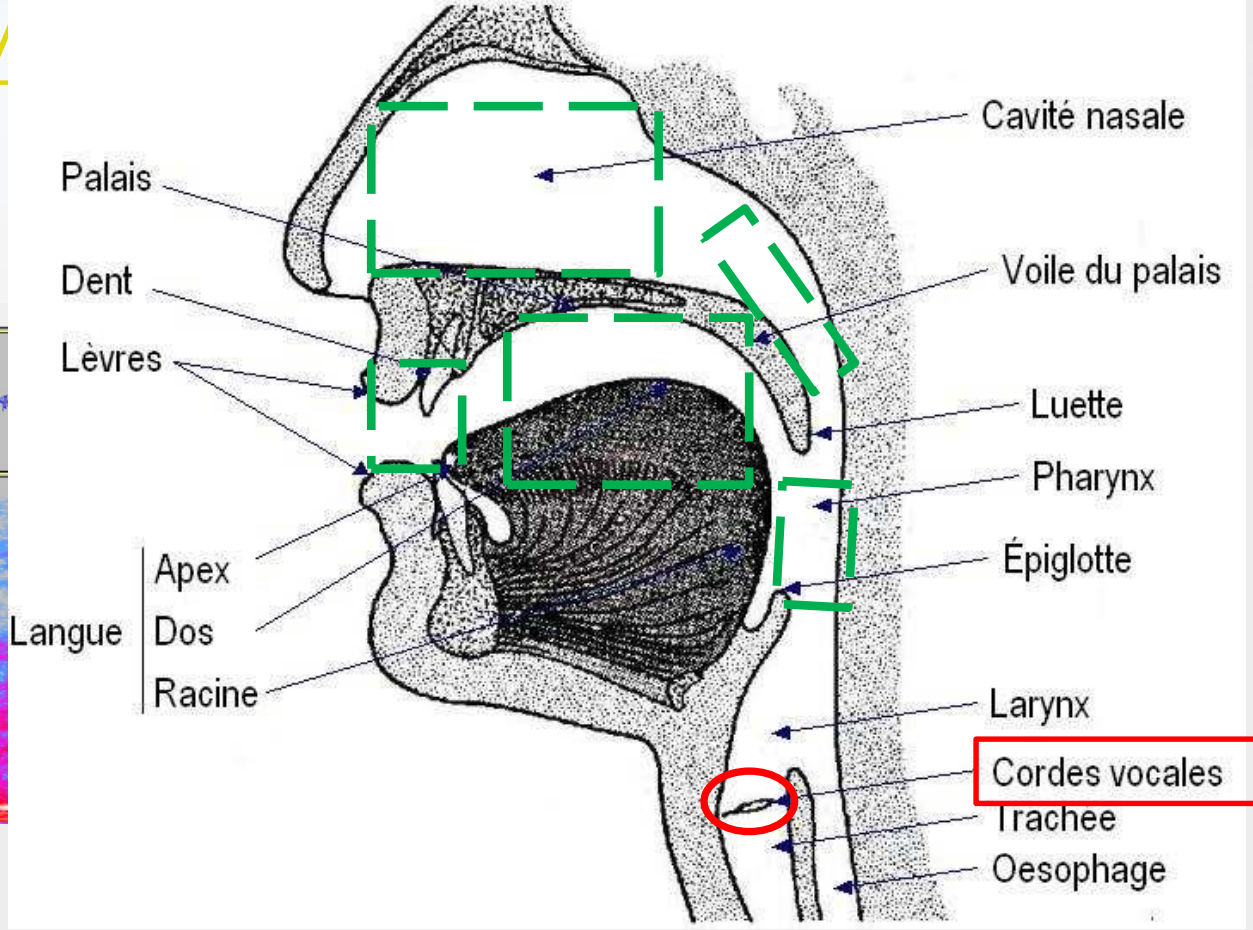
La production de la parole s'appuie sur une activité
Musculaire complexe
Différents articulateurs (masse, structure, mouvements)



Le conduit vocal – les résonateurs acoustiques

- M





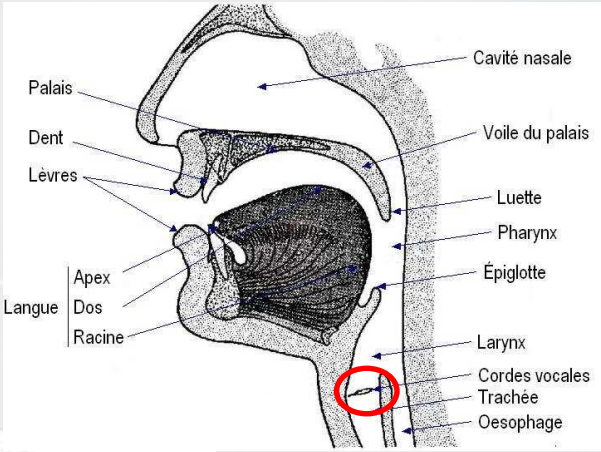
Résonateurs **acoustiques**

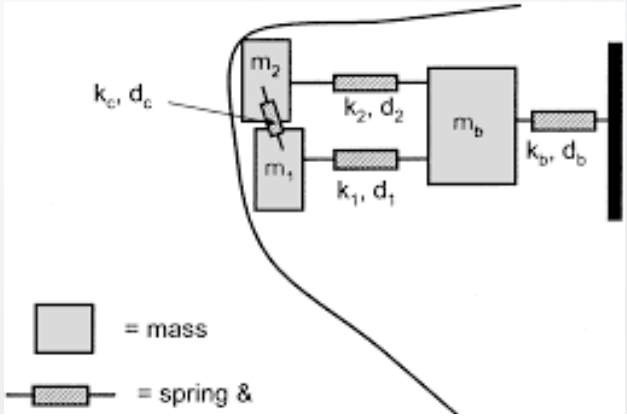
Ces résonateurs **acoustiques**, modifient le signal de la source, ils jouent le rôle de filtres **acoustiques**

C:\THIERRY\SFP\MECAVIVANT\Motormouth Robot KTR-2 - Full Original Video.mp4

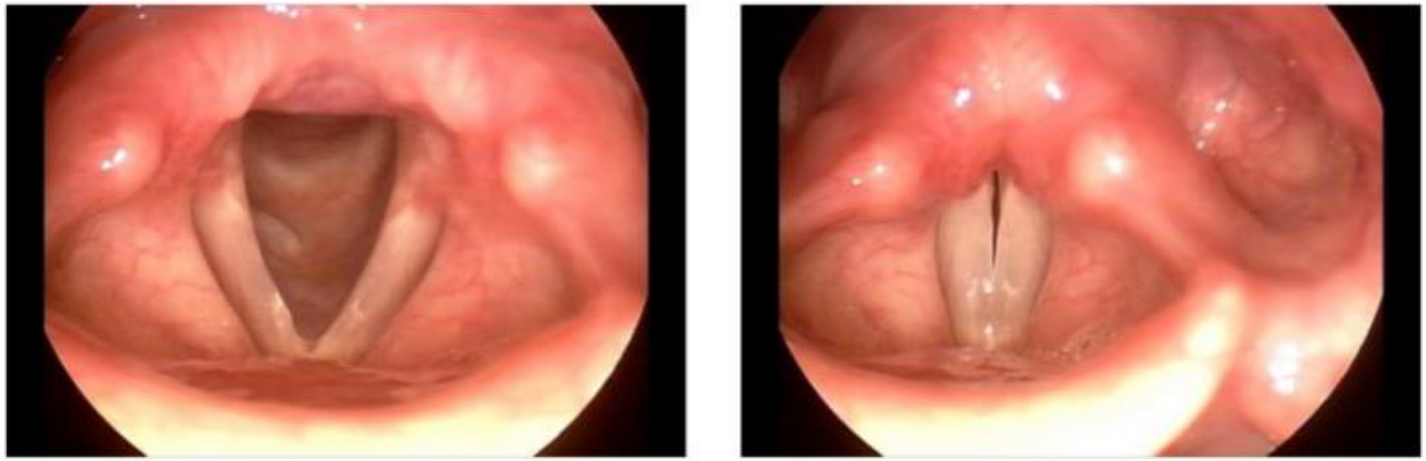
Les plis vocaux

- Two mass model – damping





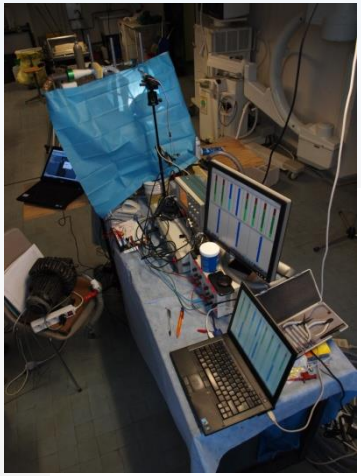
BACK

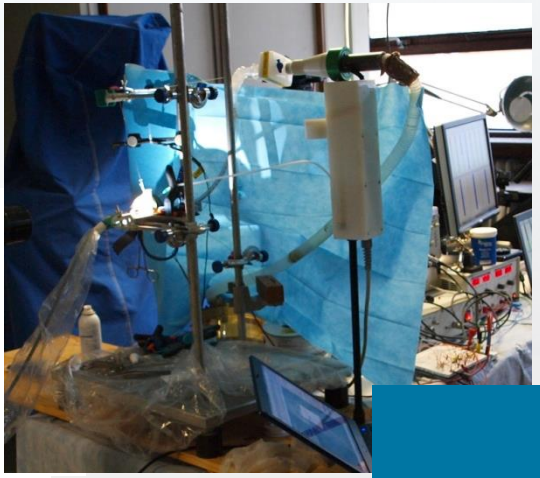


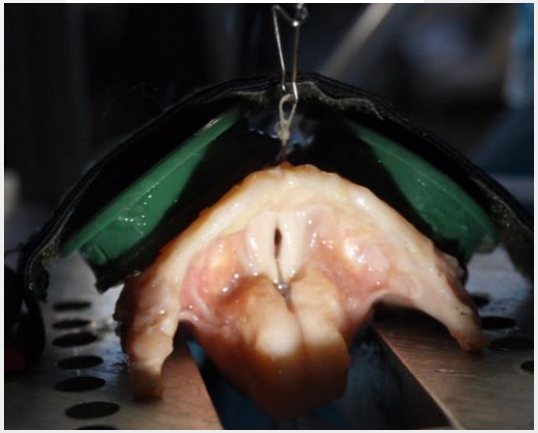
FRONT

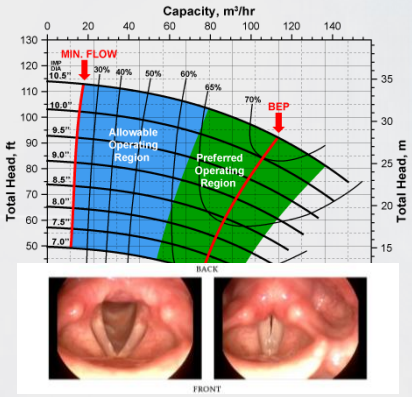
Des Meures invivo…

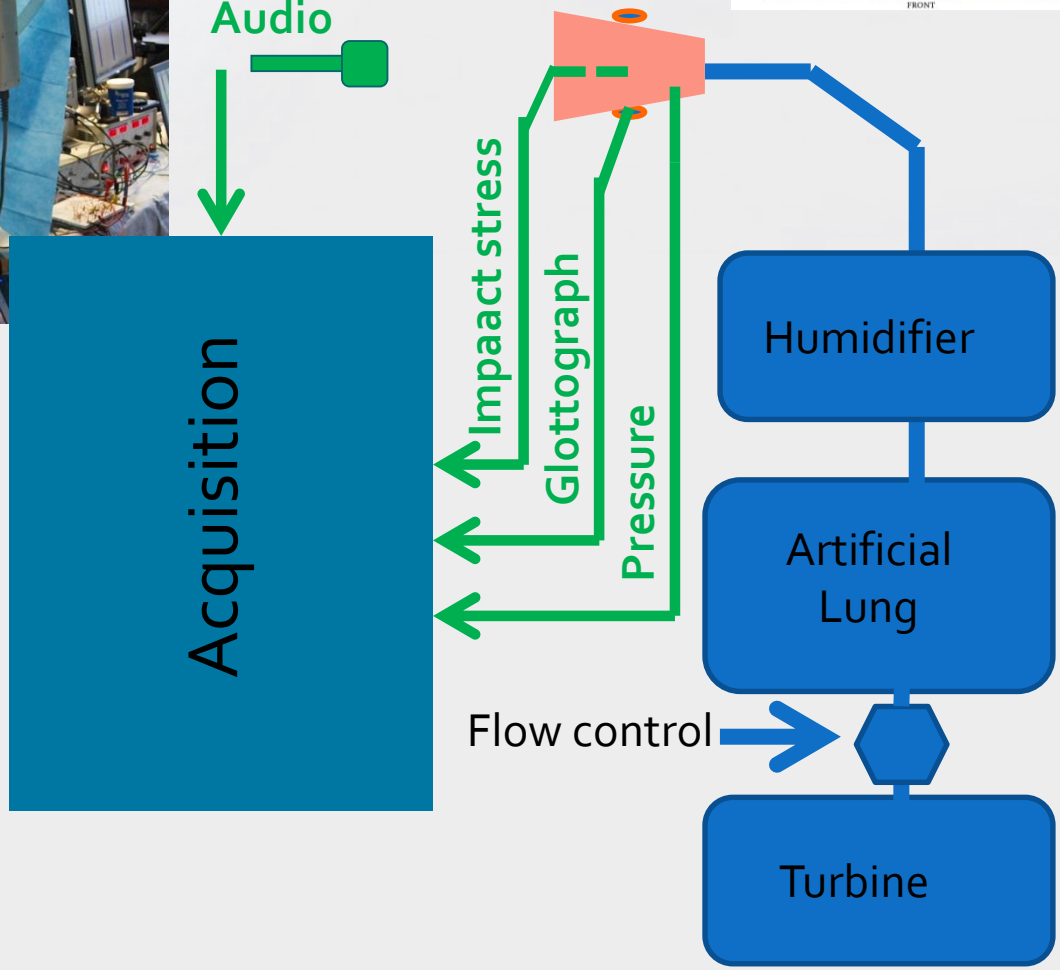
- ..\..\BANC_LARYNX\ANIMAGLOTTE\videos larynx normaux\demo.mp4

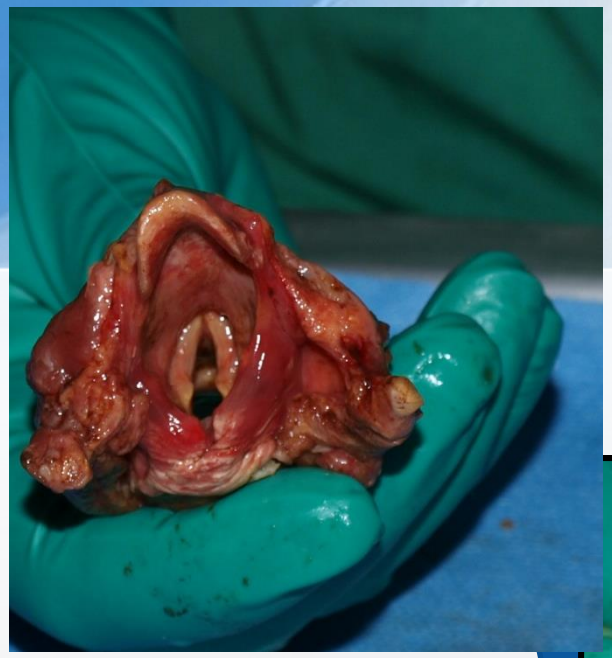


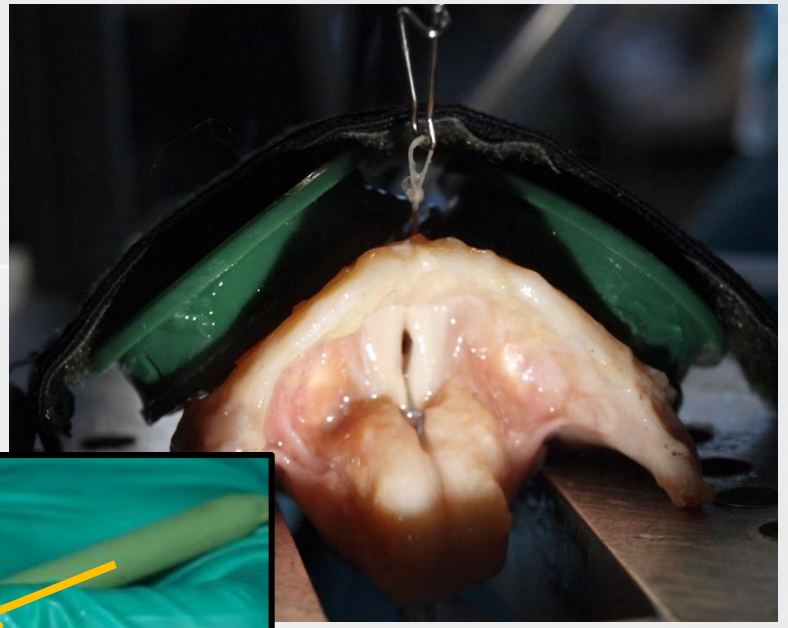


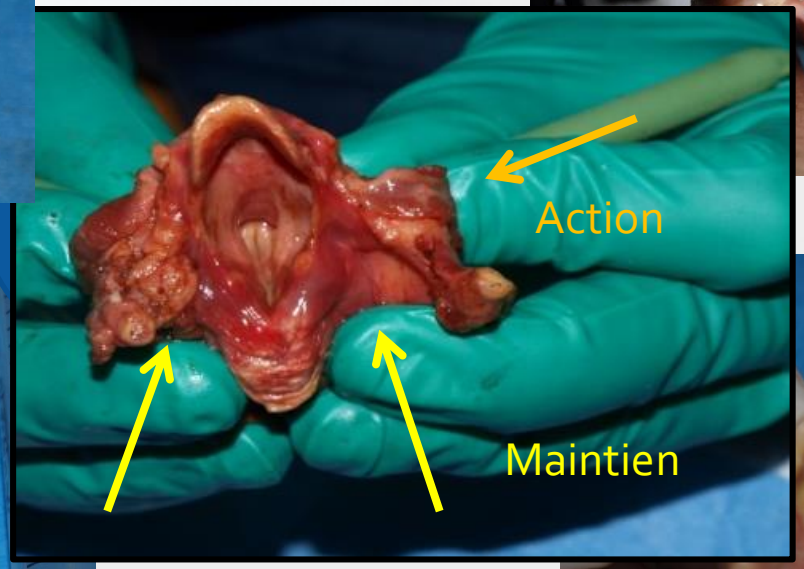



Capacity, m³/hr
MIN. FLOW
BEP
Allowable Operating Region
Preferred Operating Region
Total Head, ft
Total Head, m
BACK
FRONT


Audio
Acquisition
Impaact stress
Glottograph
Pressure
Humidifier
Artificial Lung
Flow control
Turbine






Action
Maintien

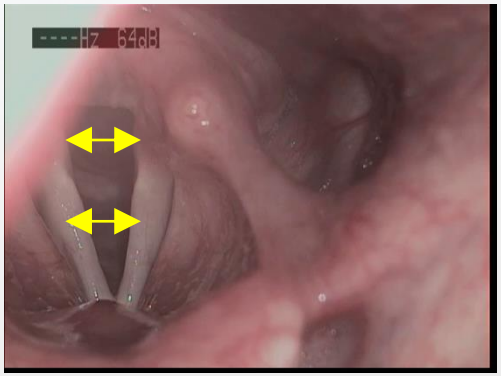
Idée directrice du projet:

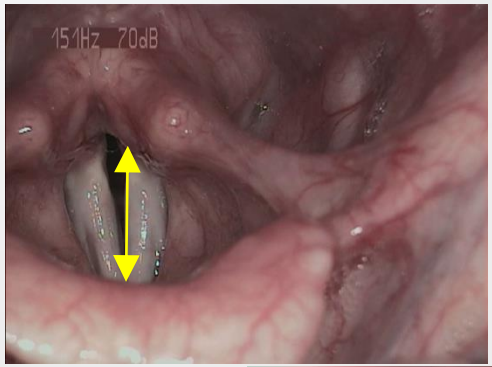
Développer un système mécanisé d'animation pour des larynx humains excisés

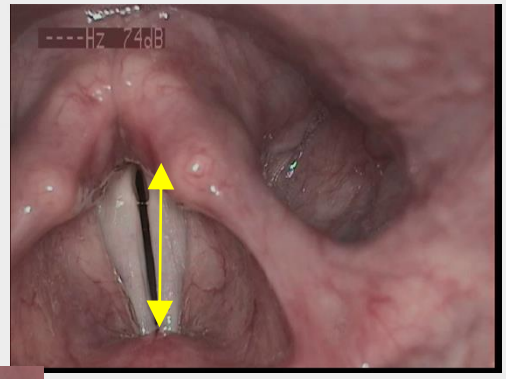
Approche / Méthode:

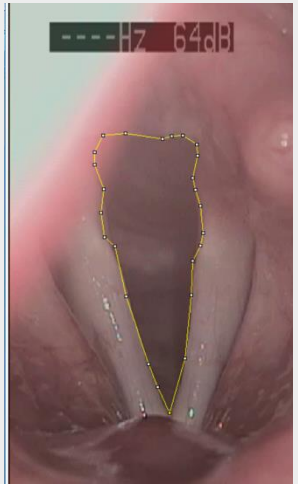
Après avoir mesuré in vivo la dynamique (amplitude et vitesse) de la glotte

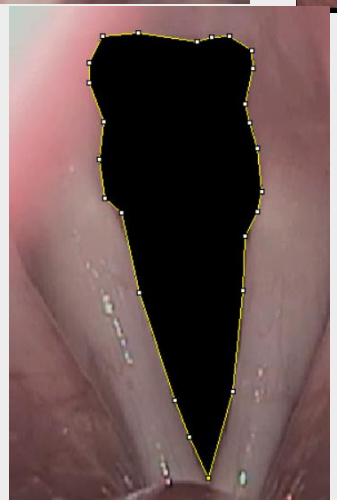
->reproduire par un contrôle mécanique artificiel cette dynamique







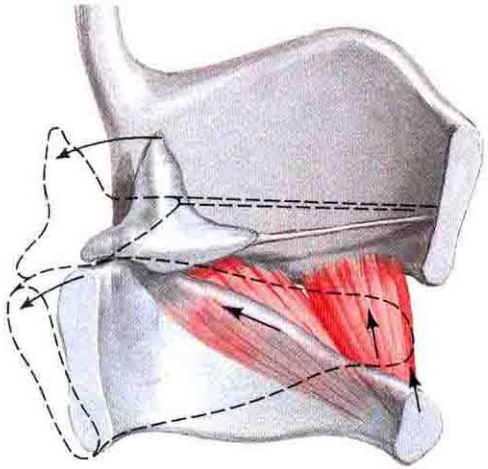




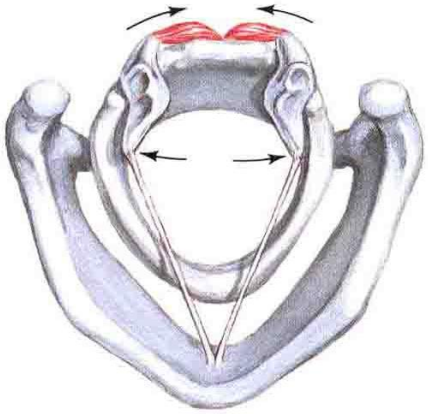
Contrôle Mécanisé

- Contrôler la configuration du plan glottique pour:
  - Position pré-phonatoire (pour point de fonctionnement réaliste)
  - Introduction possible d'asymétries
  - Mesure de l'effet de l'aire glottique sur phonation (onset /offset de phonation, pression transglottique,…)
  - Etude de différents types/modes de phonation
    - Fry, chuchotement, coup de glotte,…..

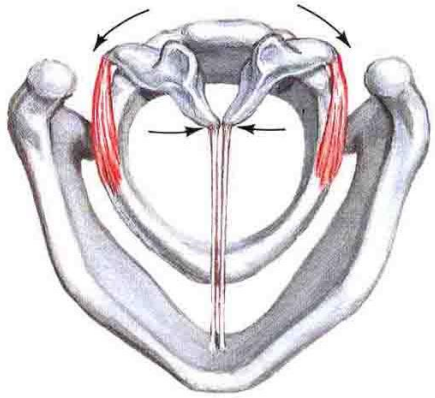
Les muscles Laryngés Intrinsèques



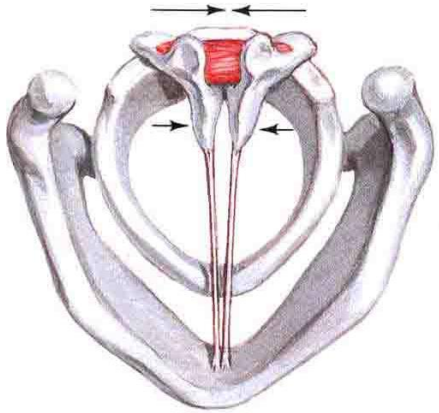
Action of cricothy
Lengthening (tension



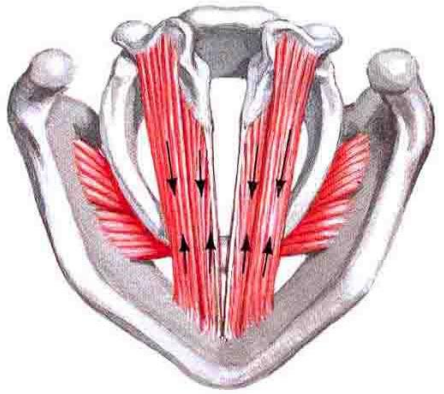
Action of posterior cricoarytenoid muscles
Abduction of vocal folds



Action of lateral cricoarytenoid muscles
Adduction of vocal folds



Action of transverse arytenoid muscle
Adduction of vocal folds

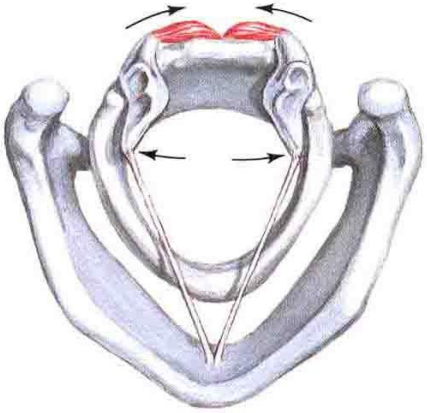


Action of vocalis and thyroarytenoid muscles
Shortening (relaxation) of vocal folds

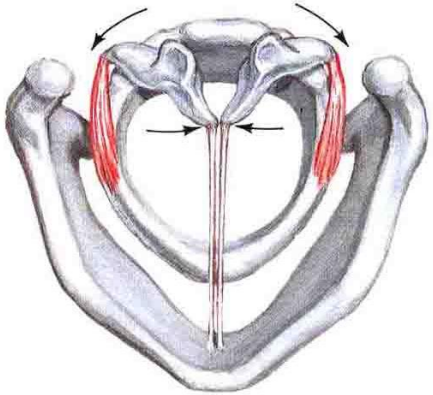
➔ **reproduire les différentes configurations laryngées**

Actions appliquées aux larynx possiblement différentes des conditions « naturelles »

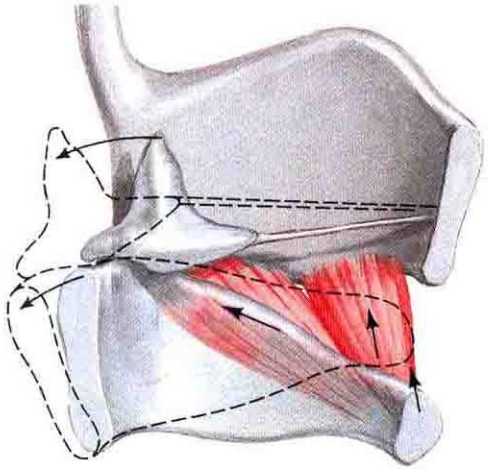
Les muscles Laryngés Intrinsèques



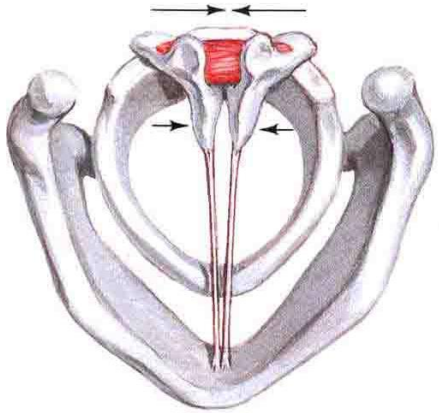
Action of posterior cricoarytenoid muscles
Abduction of vocal folds



Action of lateral cricoarytenoid muscles
Adduction of vocal folds

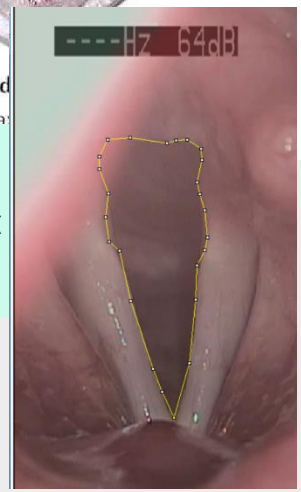


Action of cricothy
Lengthening (tension



Action of transverse arytenoid muscle
Adduction of vocal folds

Action of vocalis and
Shortening (rela

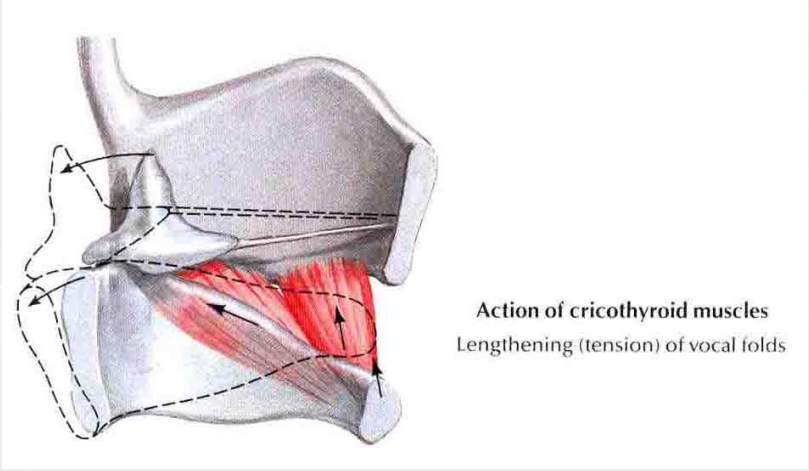


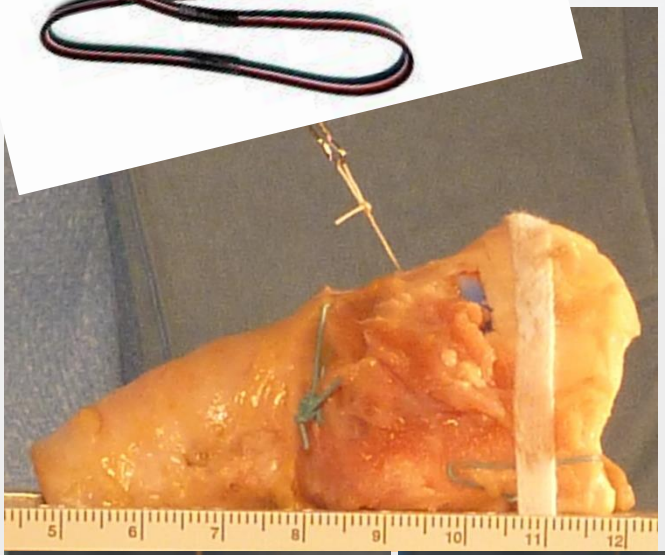
➔ **reproduire les différentes configurations laryngées**

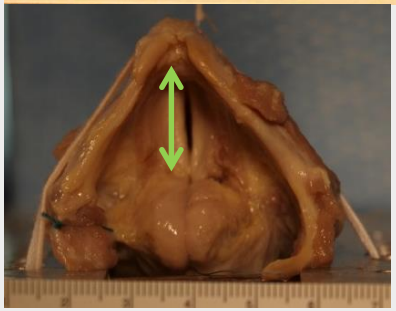
Actions appliquées aux larynx possiblement différentes des conditions «

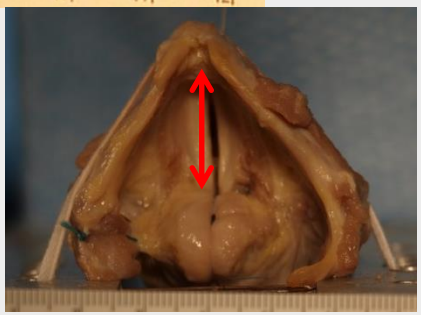
L'objectif est la reproduction des géométries de glottes

La bascule CT

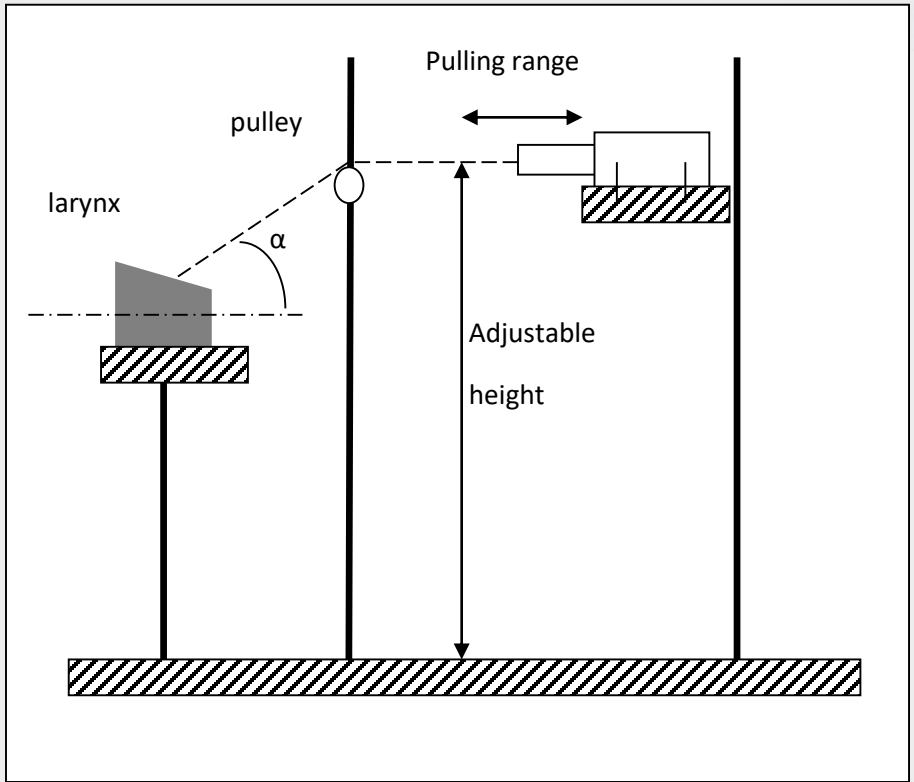




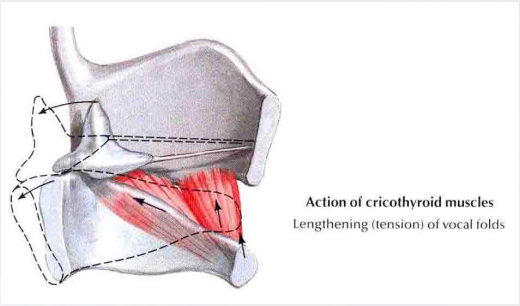


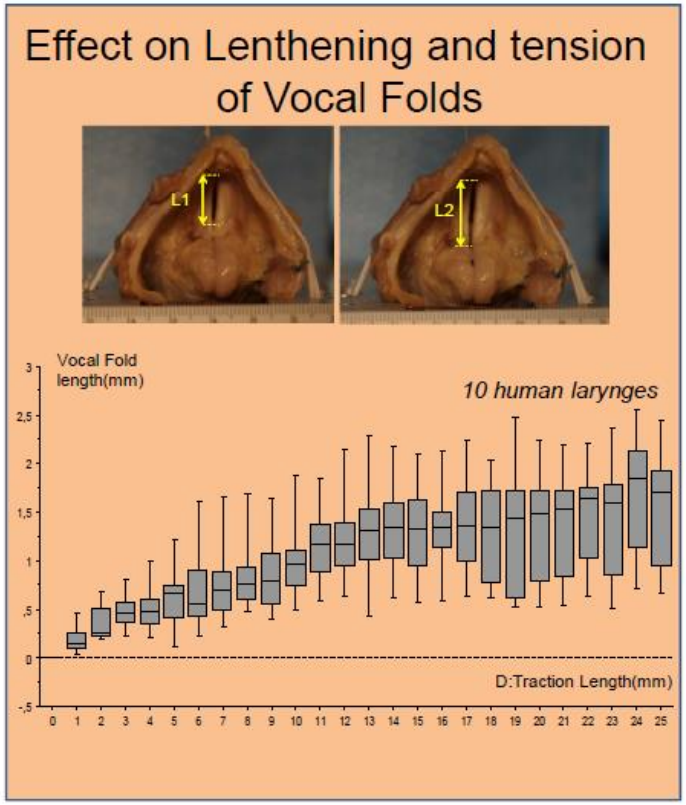


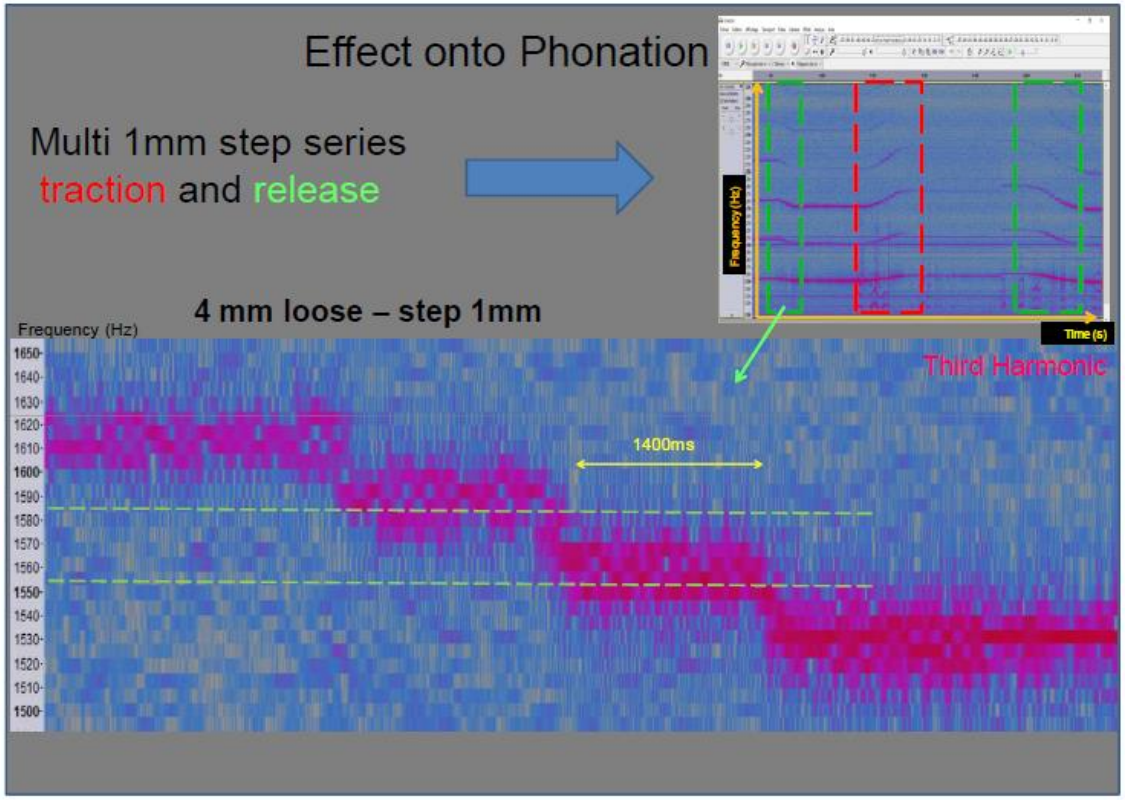
> Tension + Elongation des plis vocaux



Effets de la bascule CT







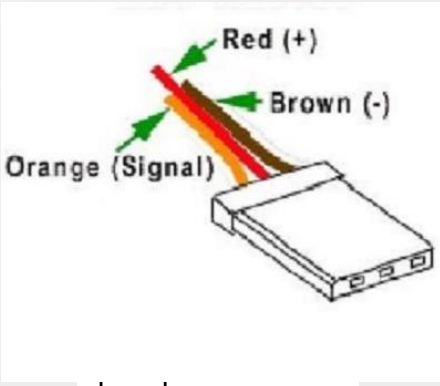
Actionneurs

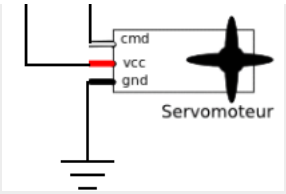
Les servo-moteurs

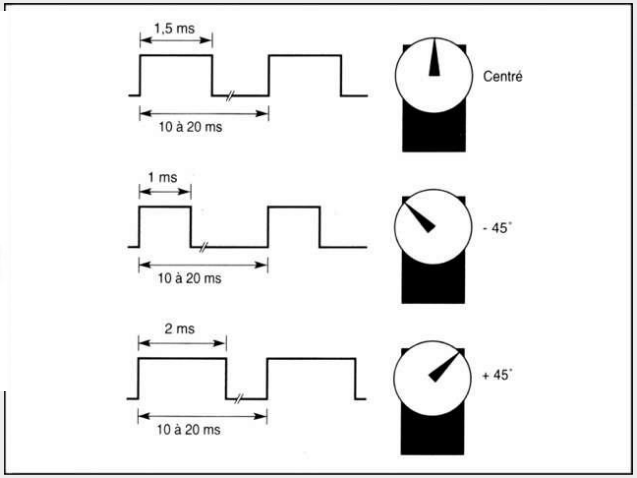
Masse tractée/poussée Maxi : 700g
Répétabilité ≈1,2mm

Actionneurs – le servomoteur

C'est la **durée de l'impulsion** qui fixe la **position angulaire**

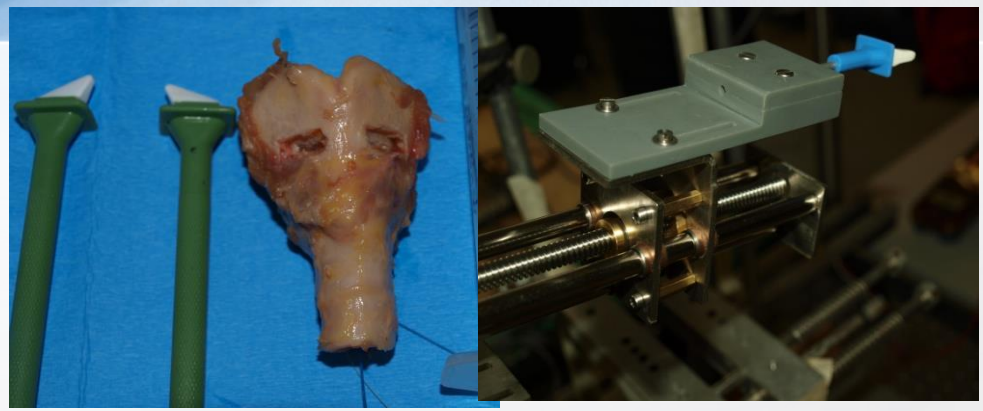


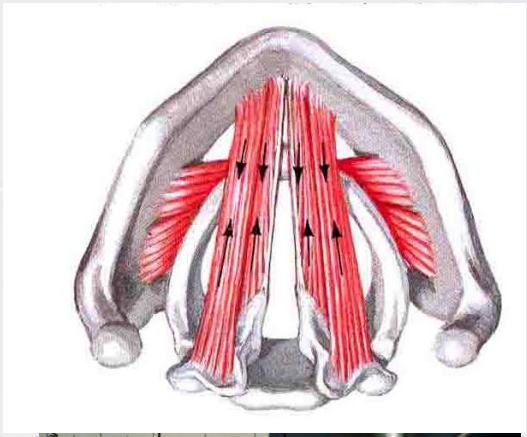


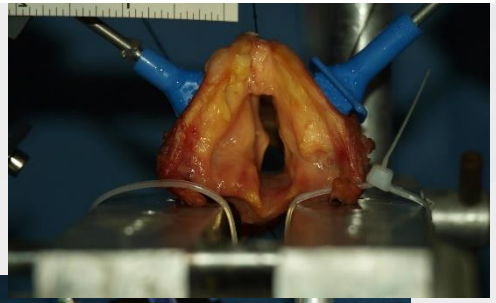


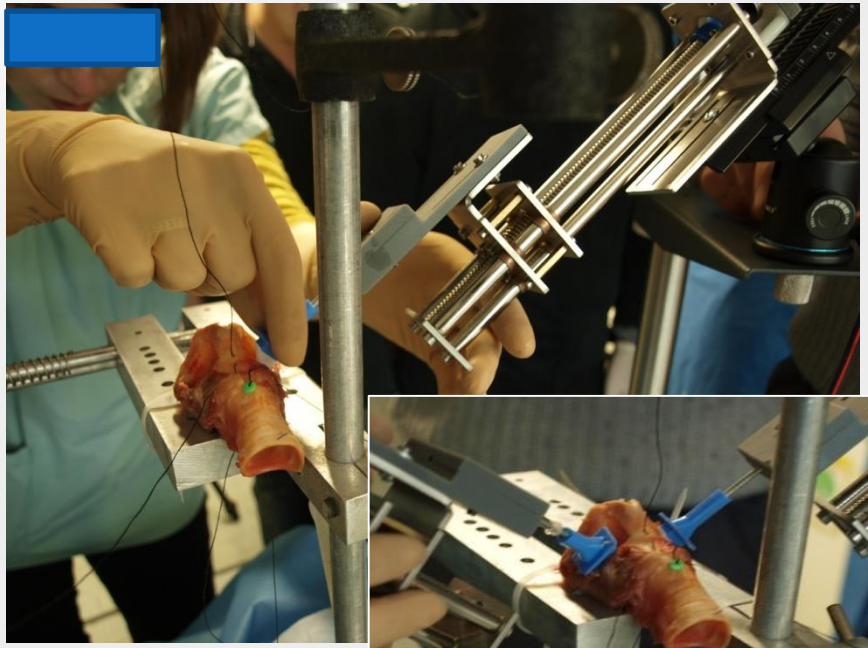
Pour l'Adduction – Antérieure & longitudinale

Utilisation d'implants de Montgomery

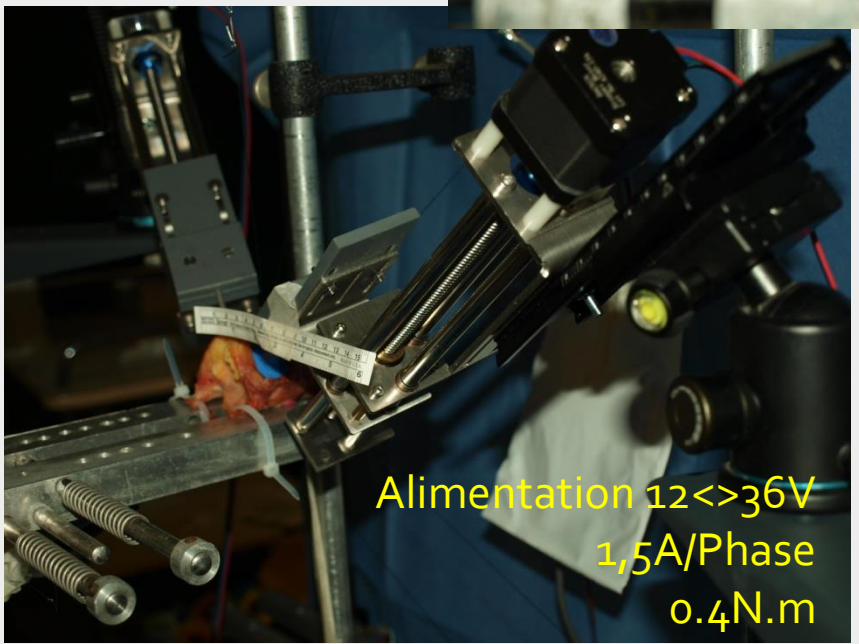




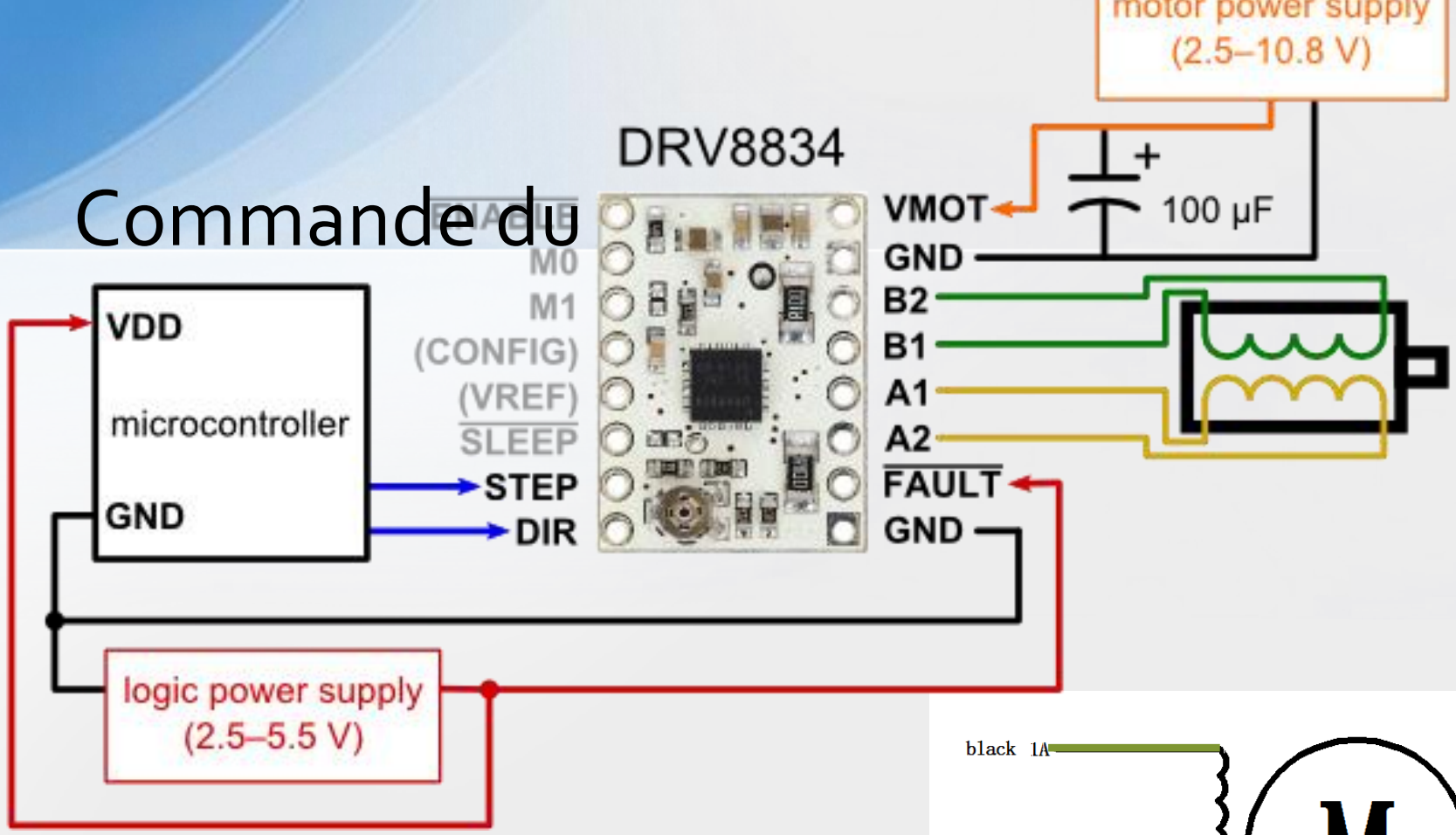


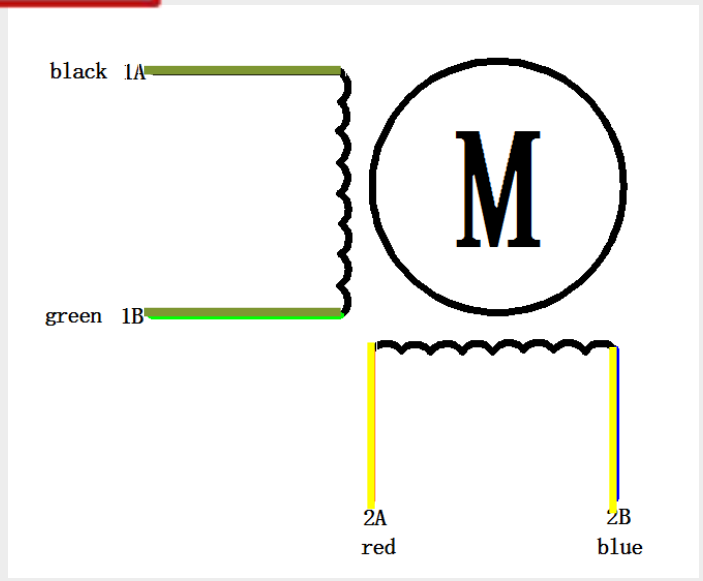


Précision < 200µm



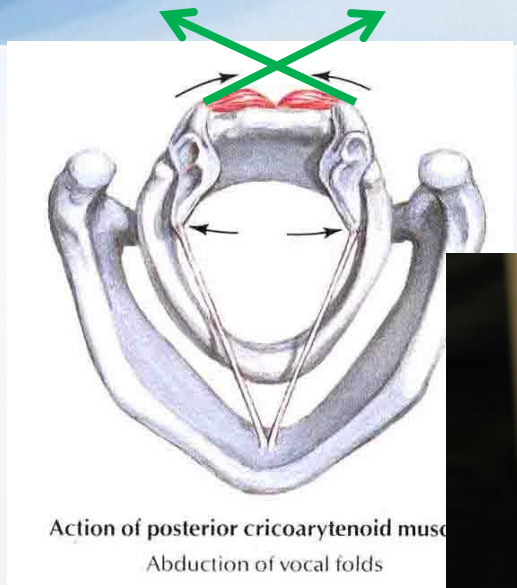
Commande du

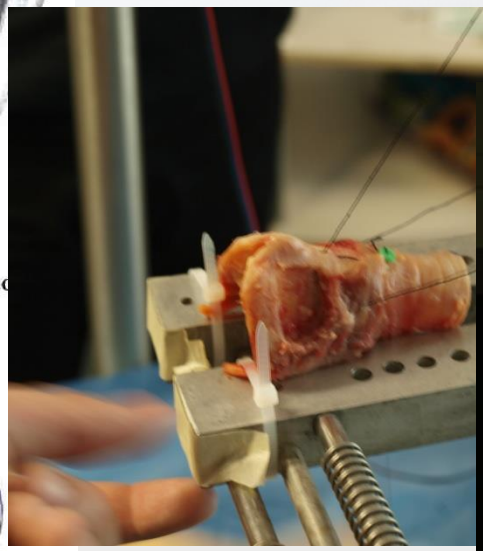

motor power supply
(2.5–10.8 V)
DRV8834
+
100 µF
VMOT
GND
B2
B1
A1
A2
FAULT
GND
M0
M1
(CONFIG)
(VREF)
SLEEP
STEP
DIR
VDD
microcontroller
GND
logic power supply
(2.5–5.5 V)

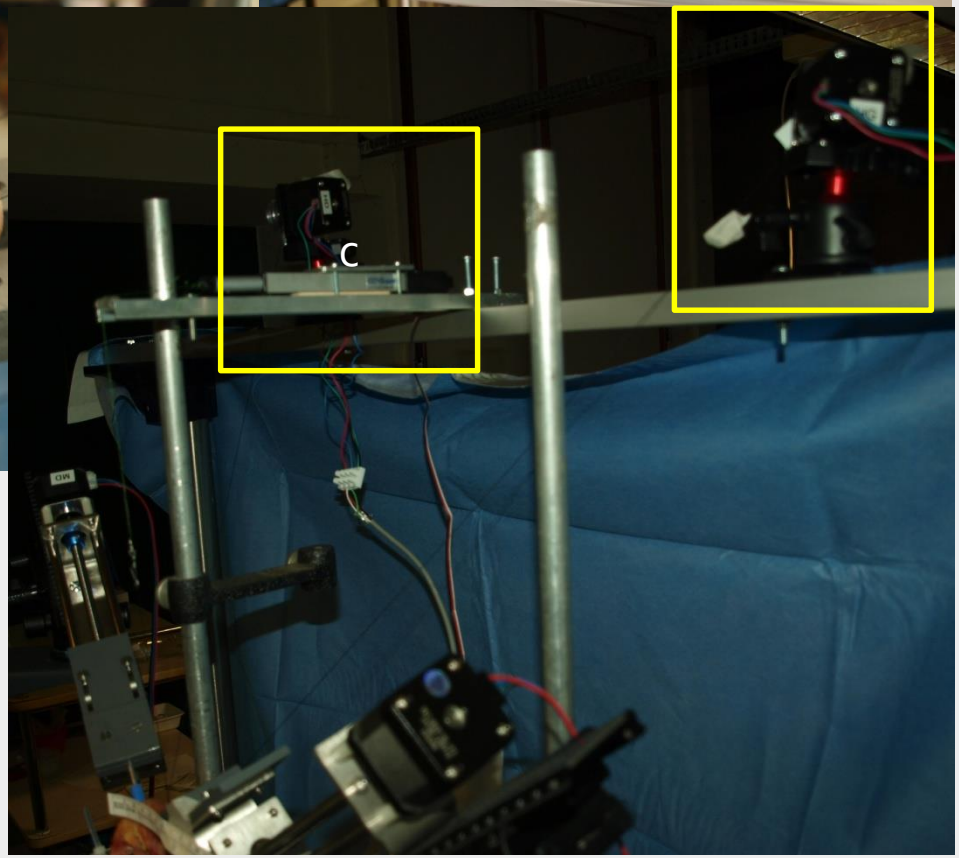

black 1A
green 1B
M
2A
red
2B
blue

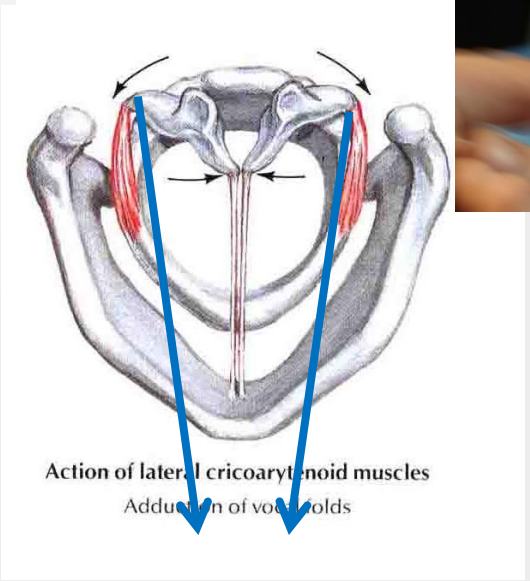
Le mouvement des arythénoïdes

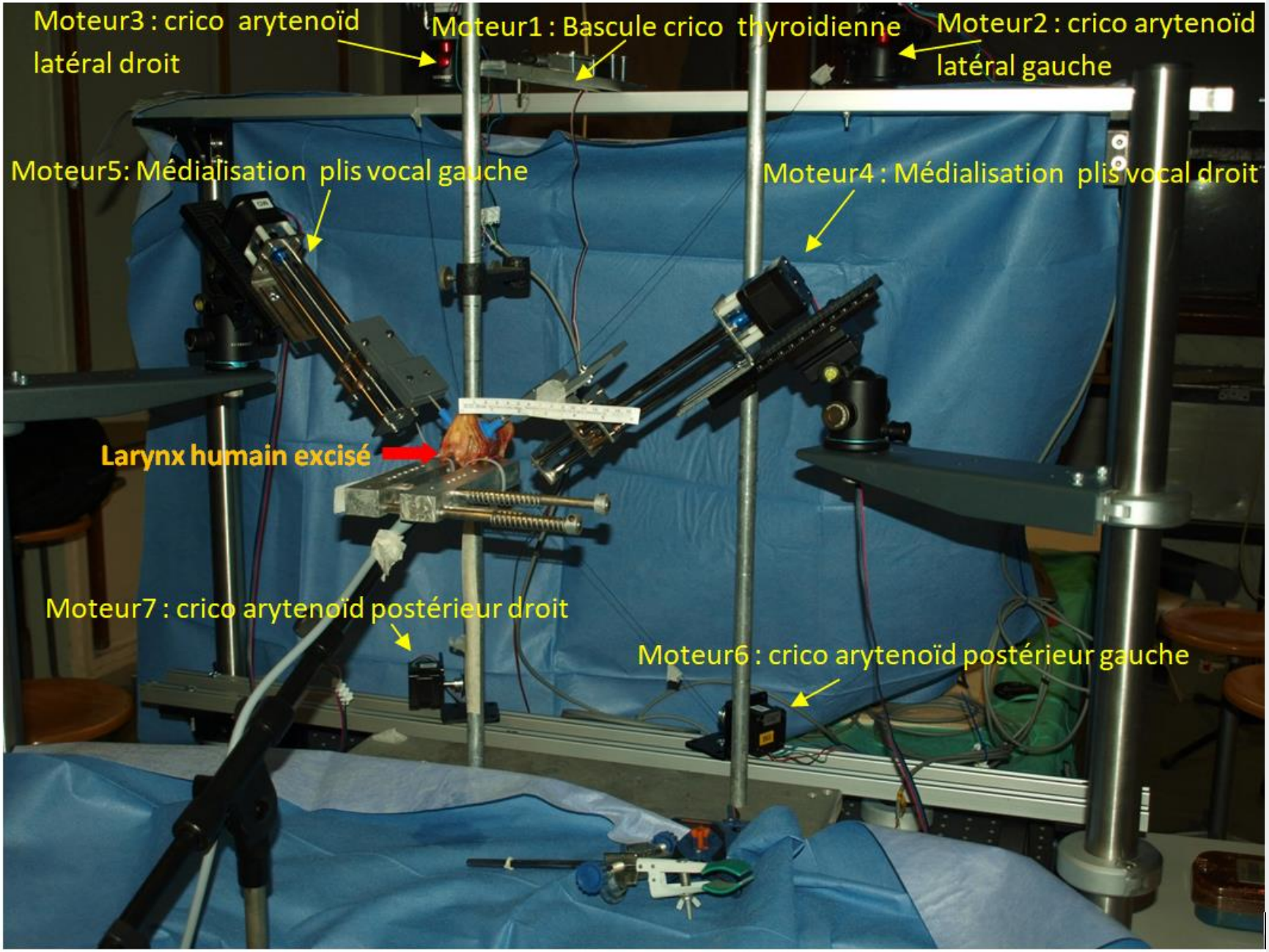
Précision angulaire < 1°
Couple de maintien 0,35N.m
Courant de phase 0,9A sous 5V



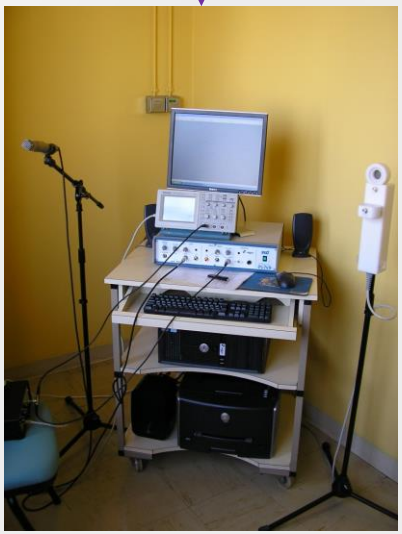


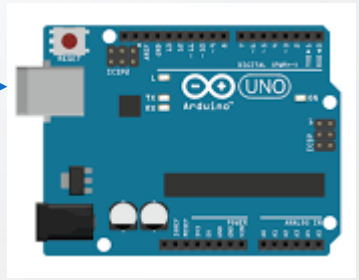


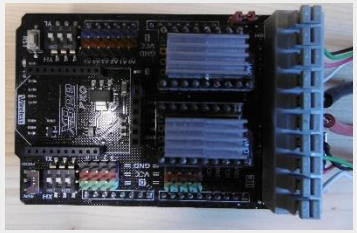


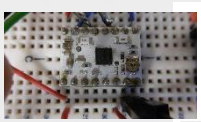

Moteur3 : crico arytenoïd latéral droit
Moteur1 : Bascule crico thyroidienne
Moteur2 : crico arytenoïd latéral gauche
Moteur5: Médialisation plis vocal gauche
Moteur4 : Médialisation plis vocal droit
Larynx humain excisé
Moteur7 : crico arytenoïd postérieur droit
Moteur6 : crico arytenoïd postérieur gauche

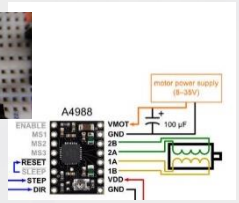
Contrôle du système

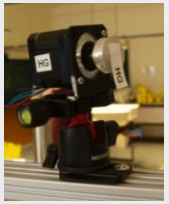


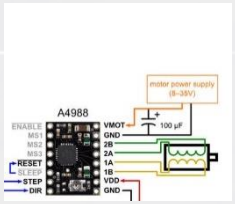


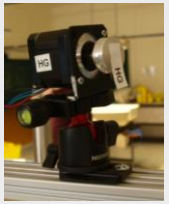


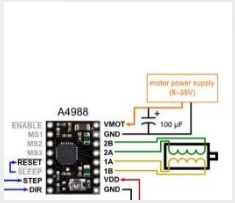


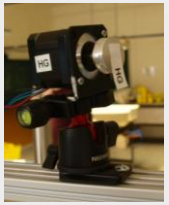


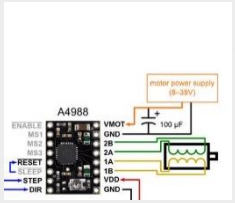


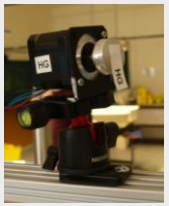


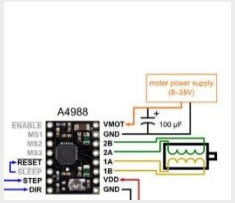


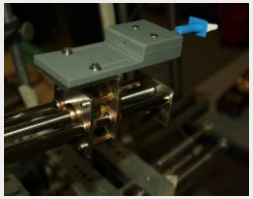


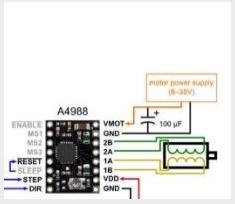


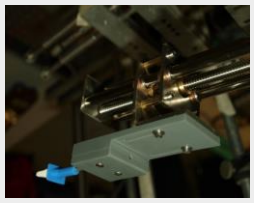








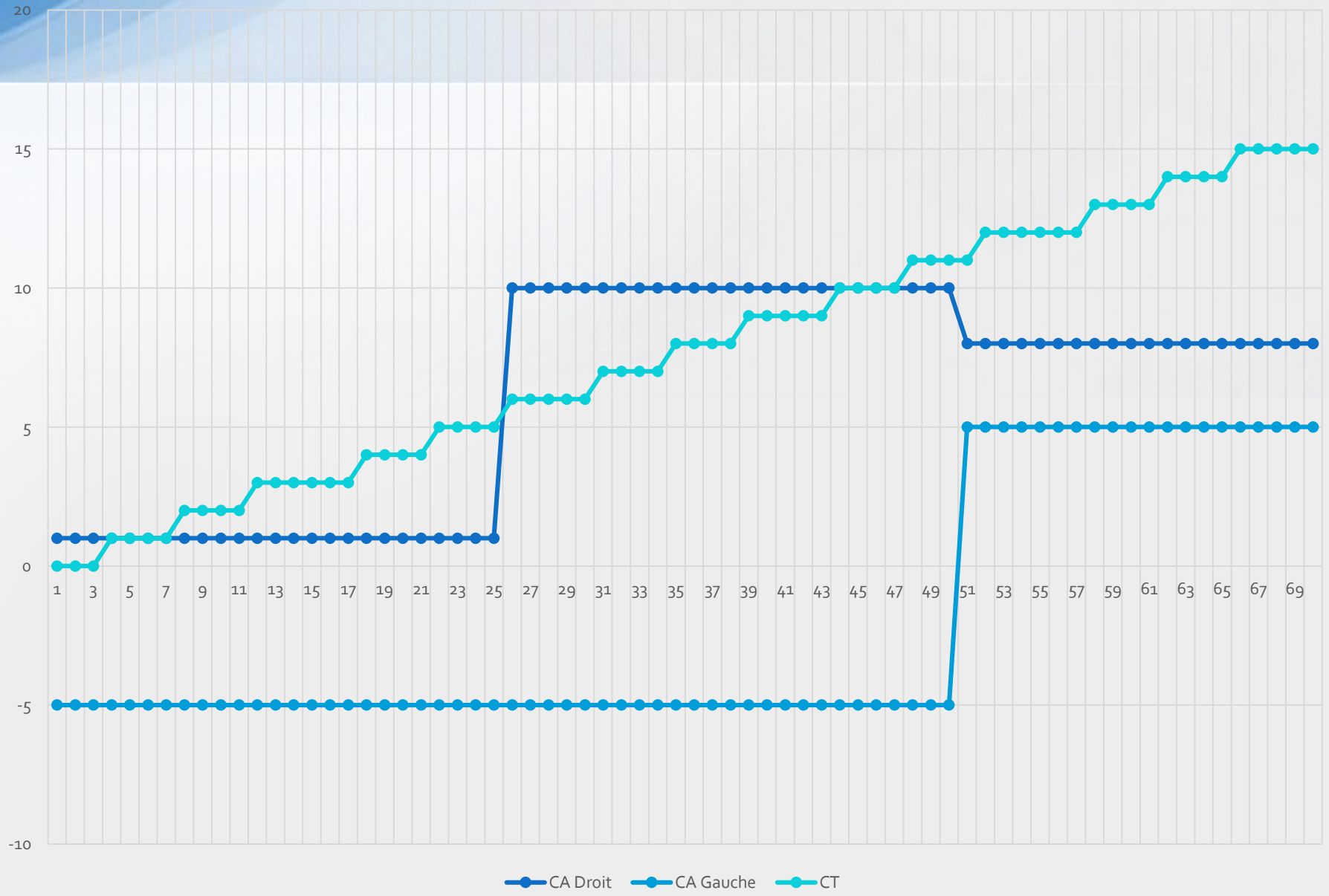


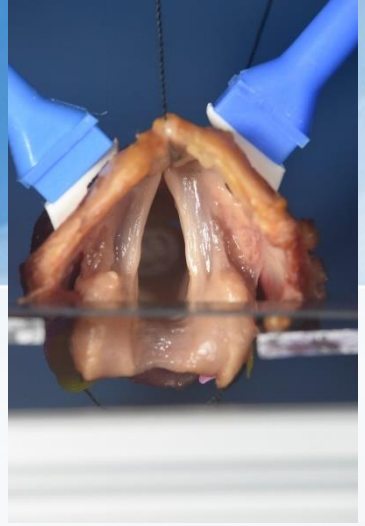


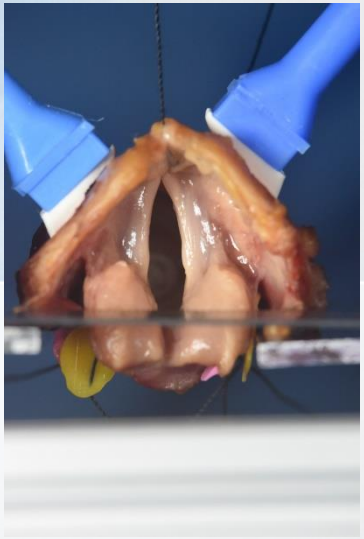
- Pour une distance ou rotation: temps alloué pour se réalisation est déterminé

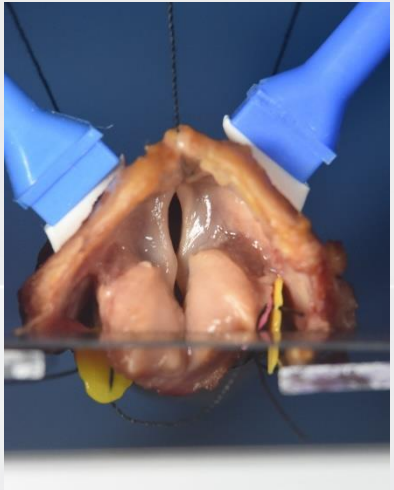
-> Action définie pour chaque moteur pour chaque pas de temps

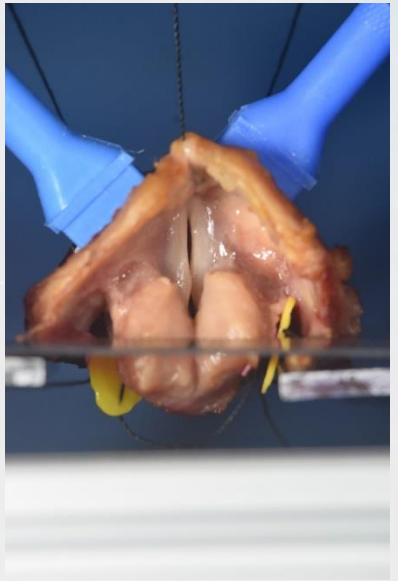
Series de commandes

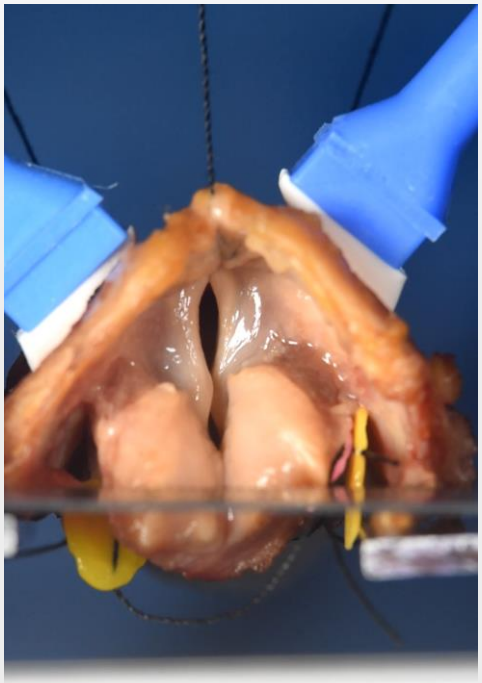




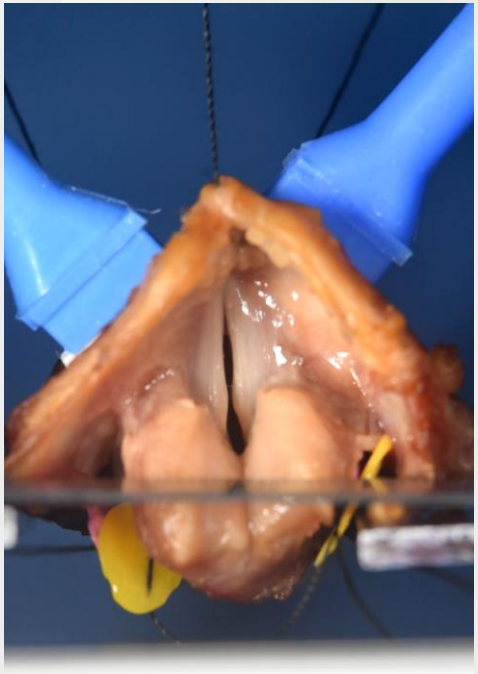








CAL D relache



Tension CT, relâche TAD TAG

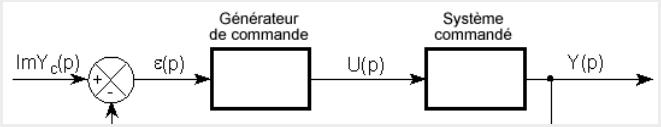
Perspectives

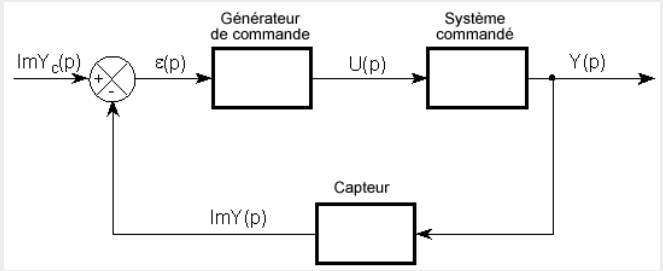
- Mesure des forces (poussée et traction) appliquées

  -> conception de pièces de maintien en impression 3D

- Activation simultanée des moteurs (gestes)

- Adaptatif en fonction de la position et de la force de poussée ou traction





Merci de votre attention