



Tecniche di reverse engineering senza contatto per la ricostruzione di geometrie e per il collaudo rapido di pezzi meccanici

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Emilia**



DIEMTech



Applicazioni Reverse Engineering DIEM-Tech

- 
- Controllo qualità su una pala di turbina**
 - Ricostruzione geometrica di canali dentali per il dimensionamento di perni in fibra**

Sistema di misura: sonda conoscan

Integrazione con CNC a 4 assi e implementazione software



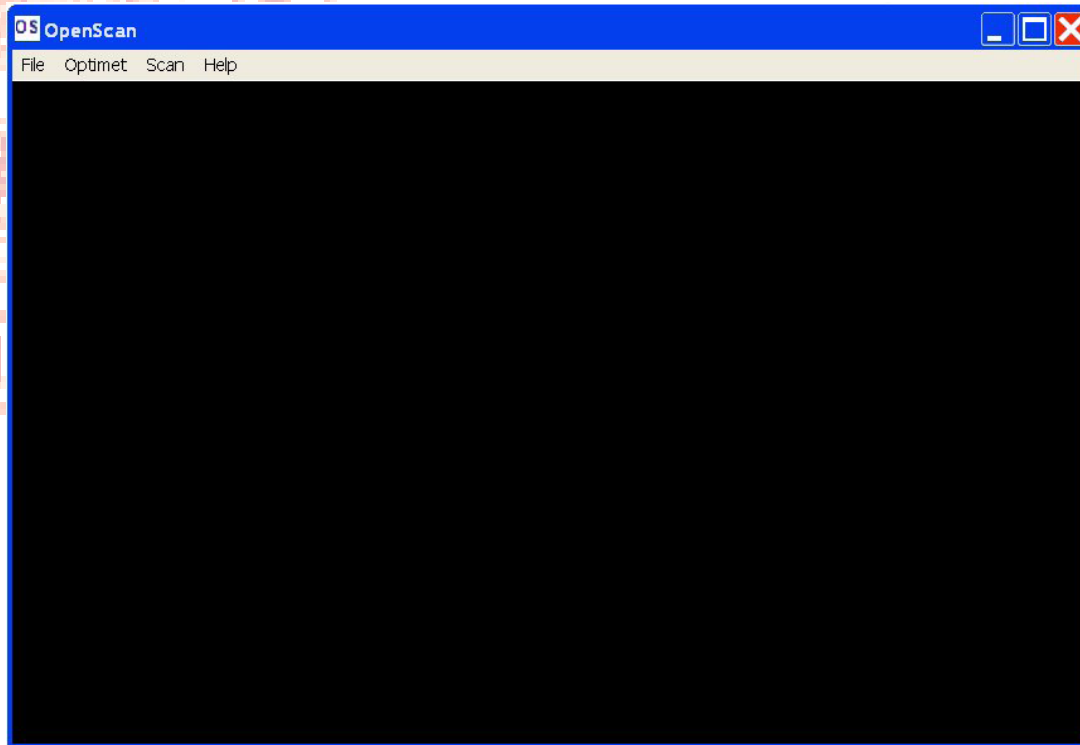
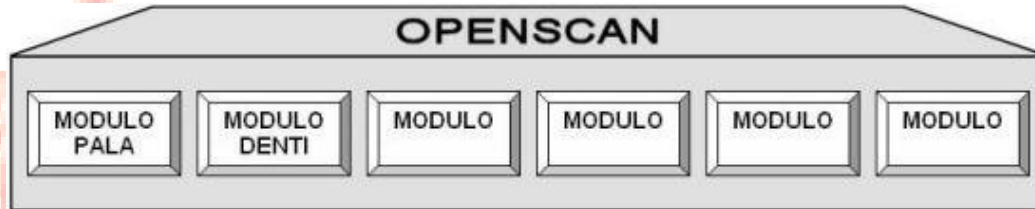
CNC



**Sonda
conoscan**



OPEN_SCAN: un software modulare



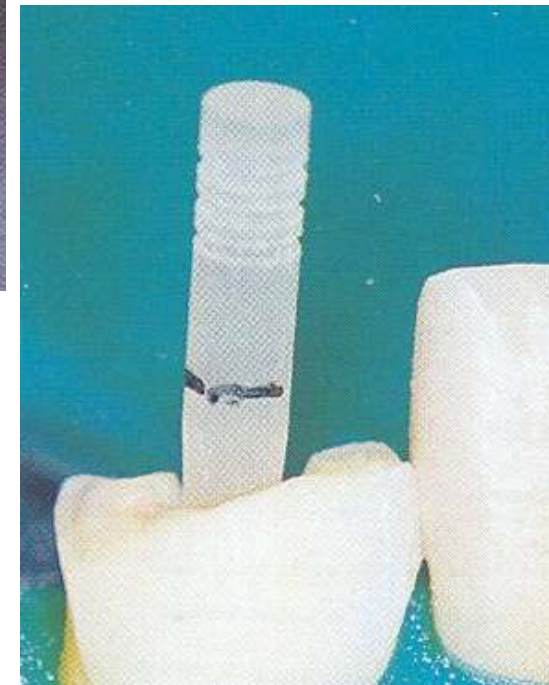
->Inserimento moduli per copiatura elementi geometrici complessi

->Sistema automatico di copiatura

Dai perni endocanalari ai perni in fibra



- Perni moncone fuso
- perni a vite filettata
- perni metallici preformati

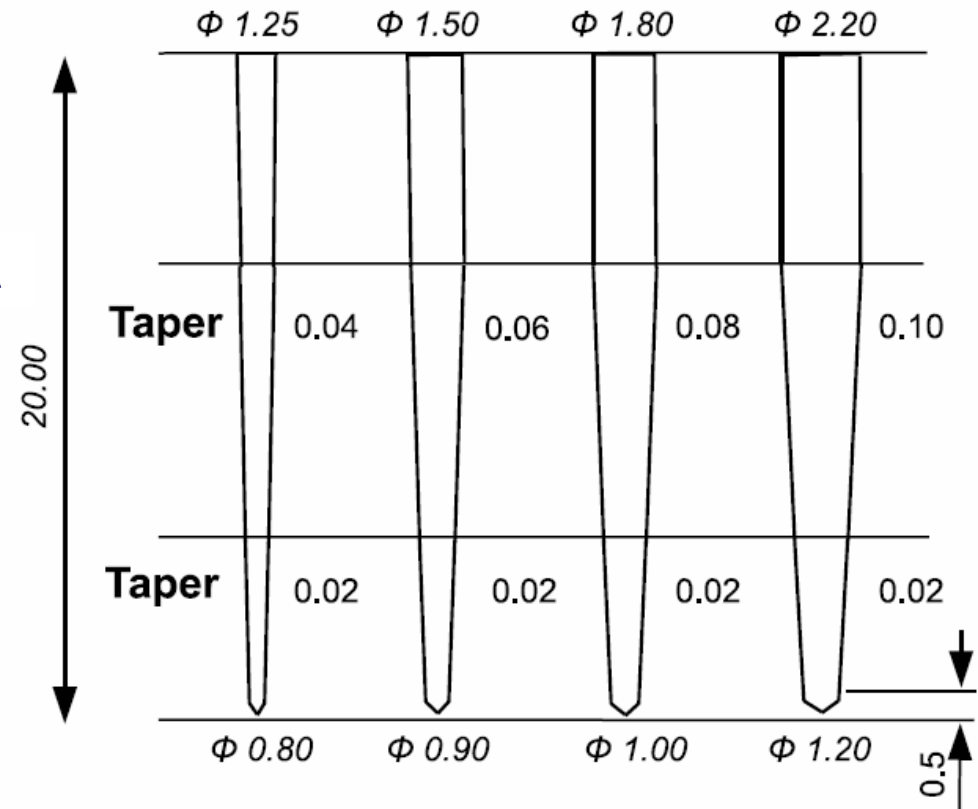


- Perni in fibra
-

Forme dei perni



Perno in fibra



Dimensionamento dei perni sulla base di dati anatomici

Sistema di scansione utilizzato: Conoscan con CNC a 4 assi



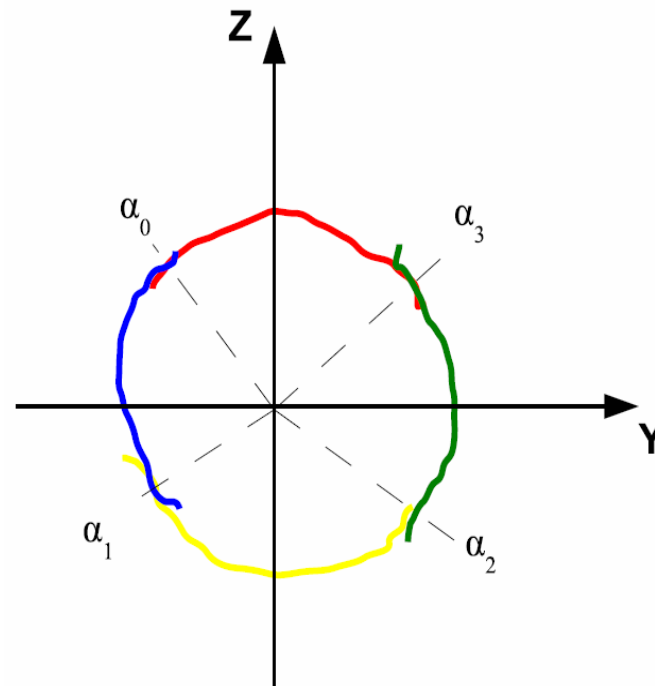
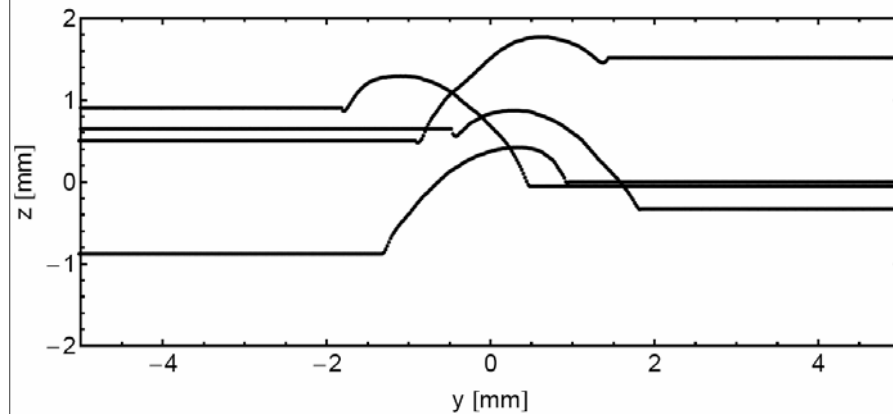
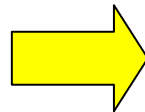
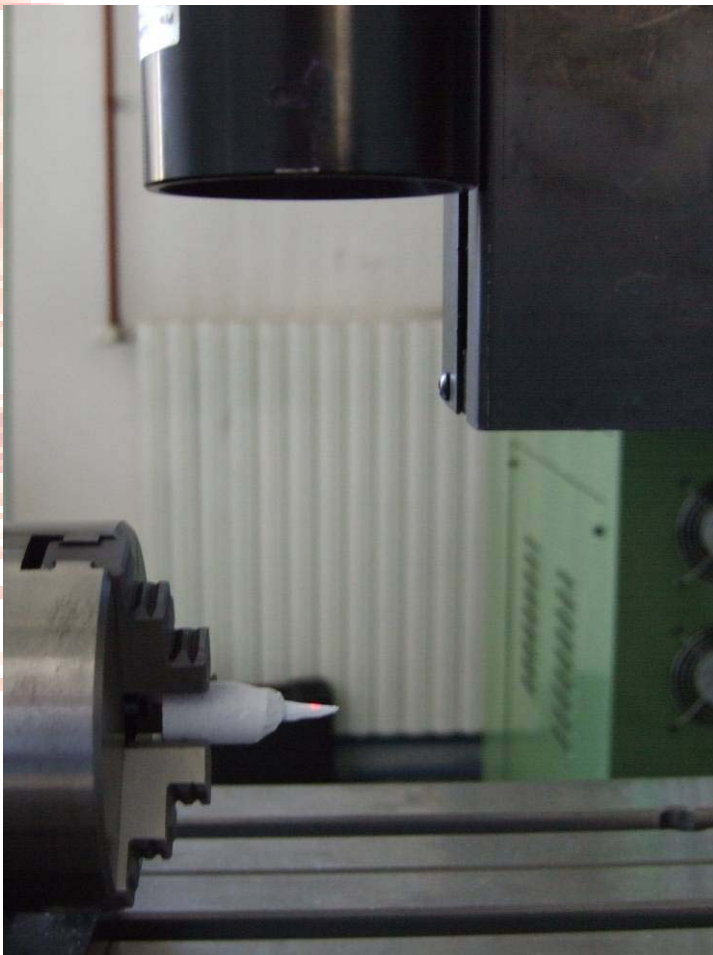
Sorgente laser

Lente (focale da 80 mm)

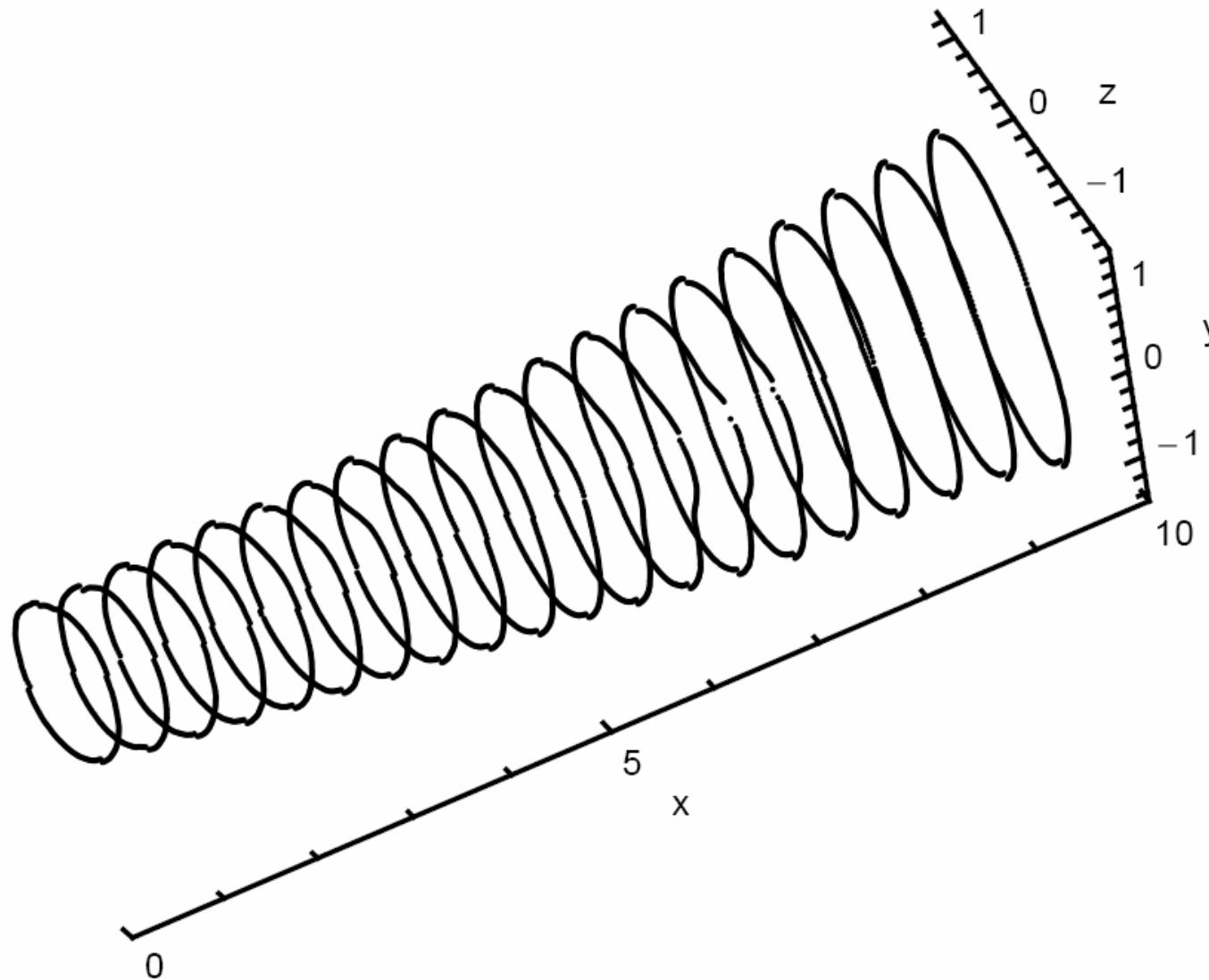
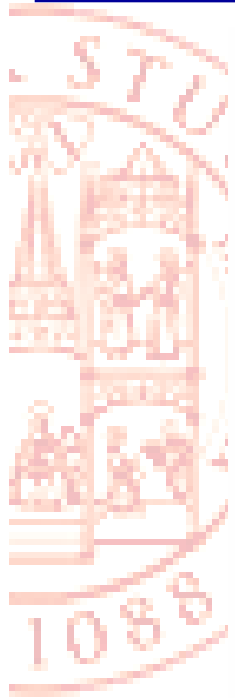
Calco canale radice
dentale



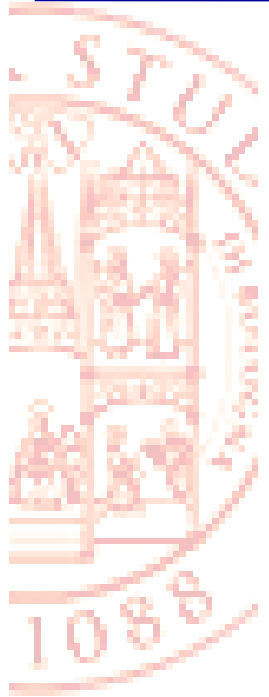
Ricostruzione del profilo geometrico di singole sezioni



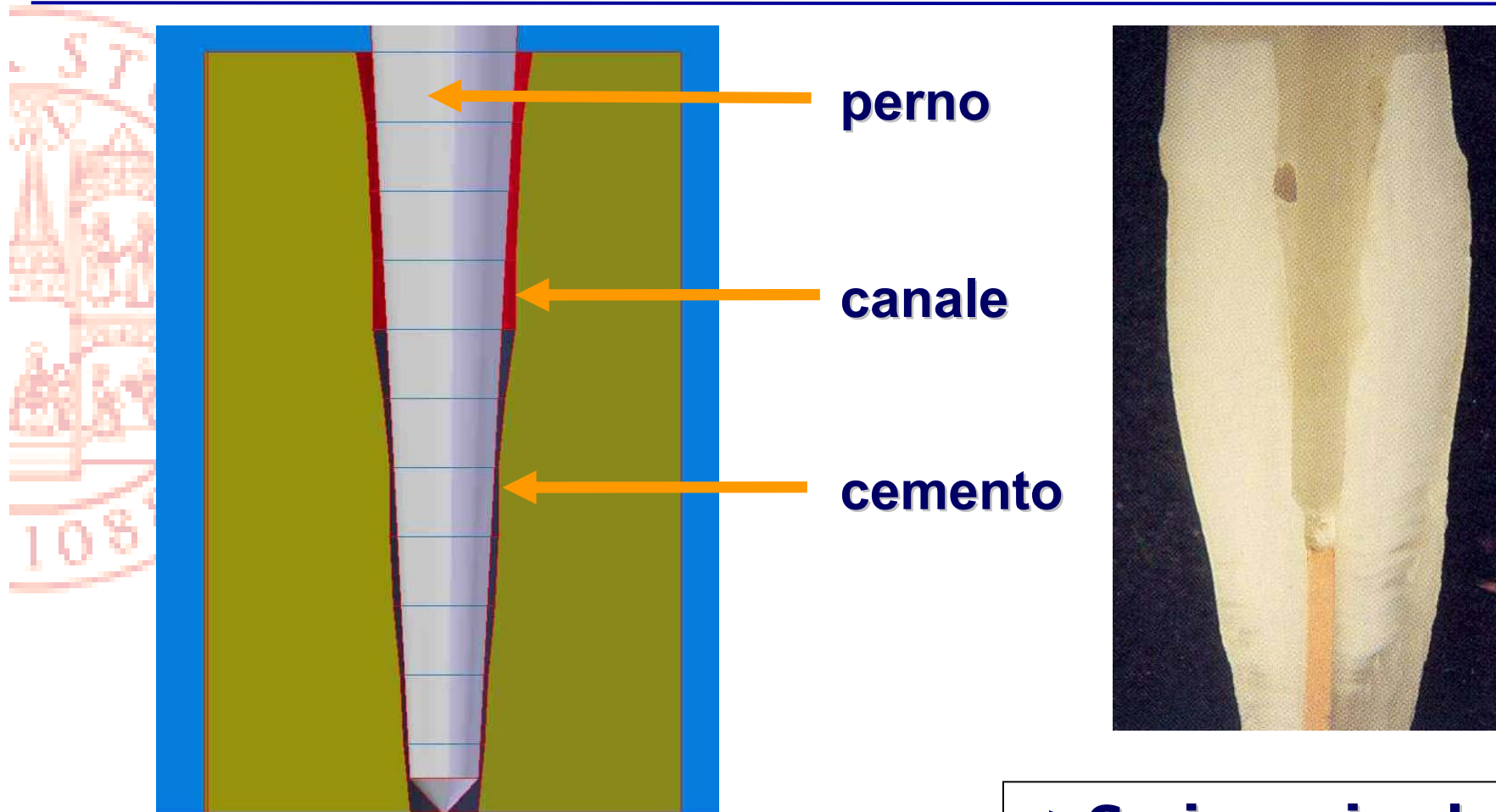
Ricostruzione 3D: acquisizione delle diverse sezioni



Ricostruzione 3D: generazione del volume



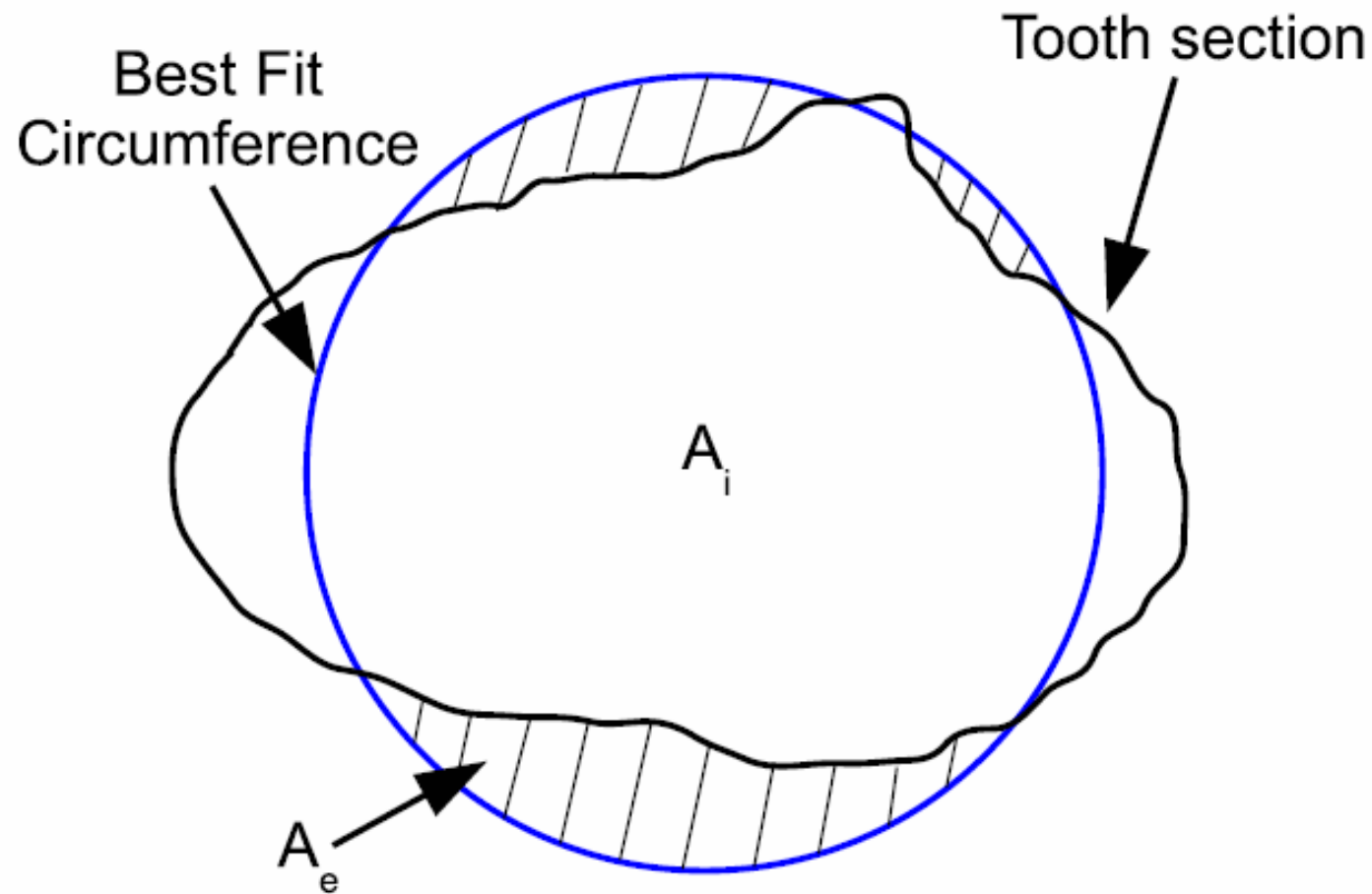
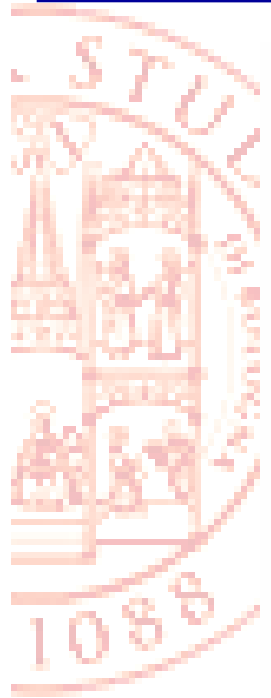
Ricerca della forma ottimale del perno



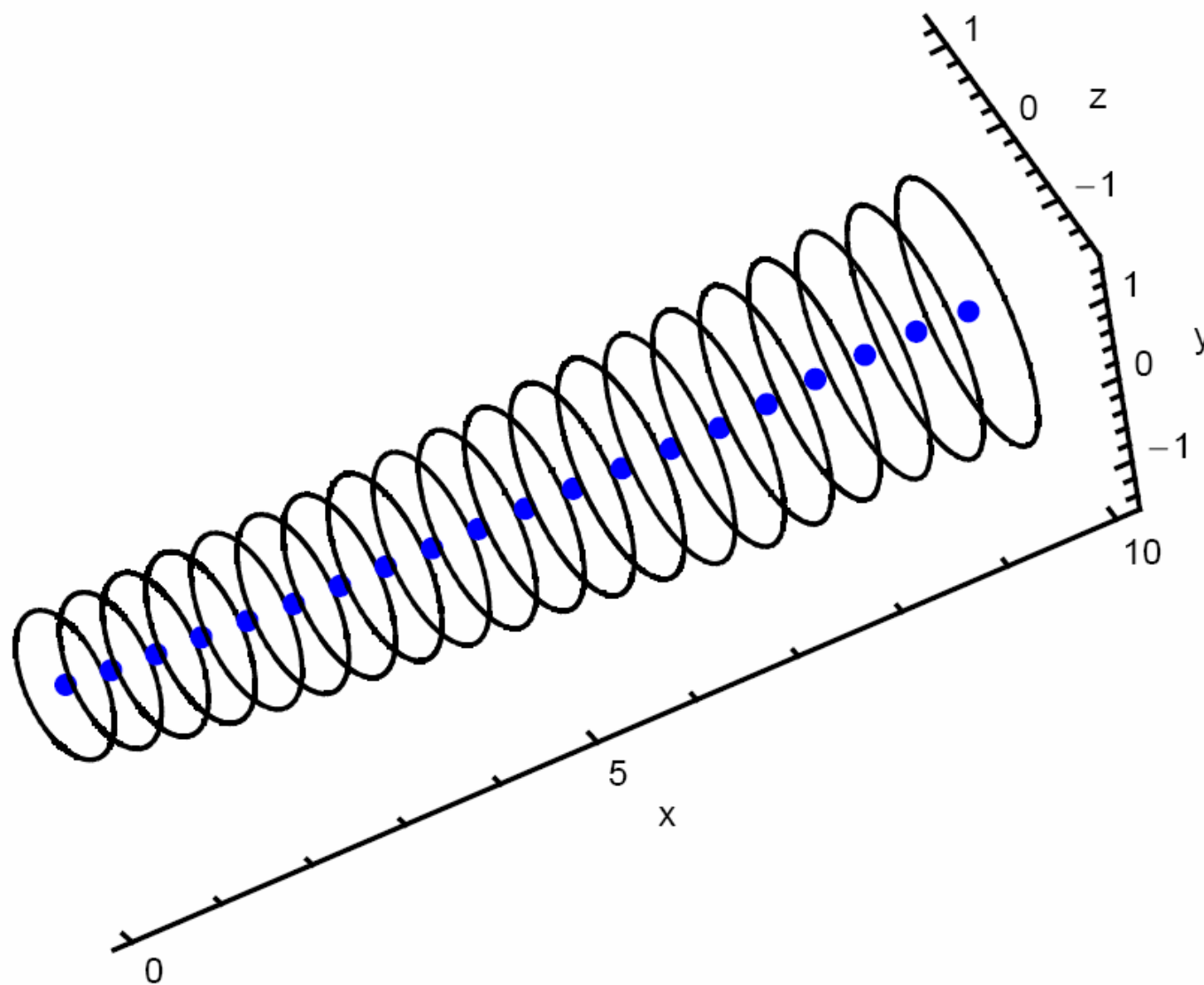
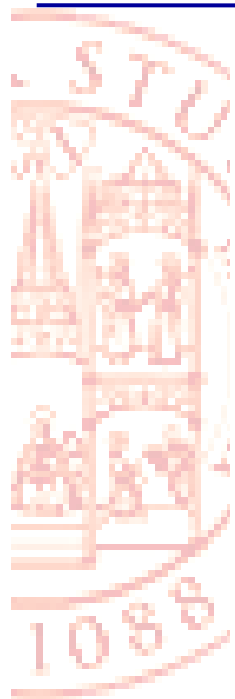
-> **Sezione circolare**

-> **Doppia conicità**

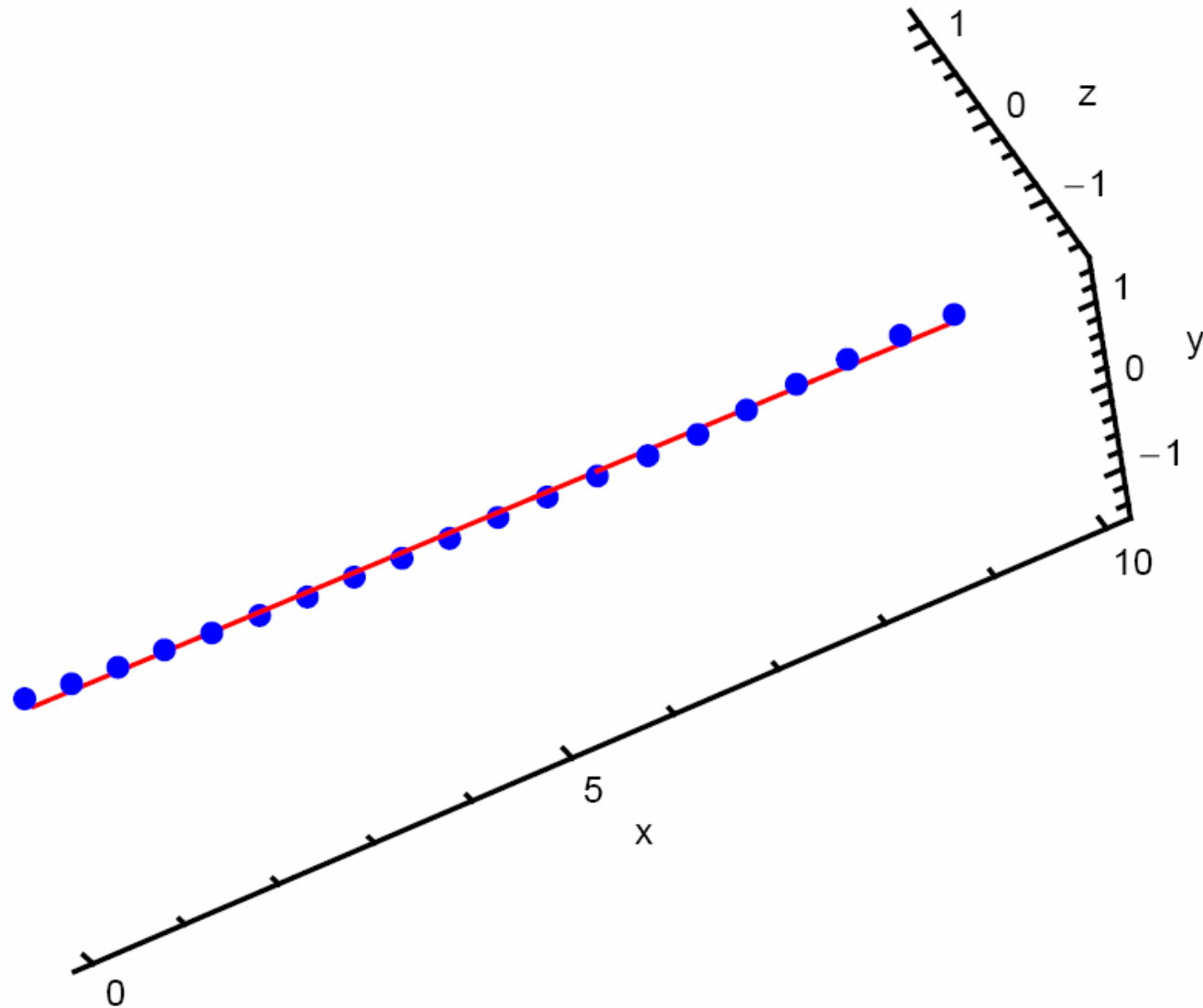
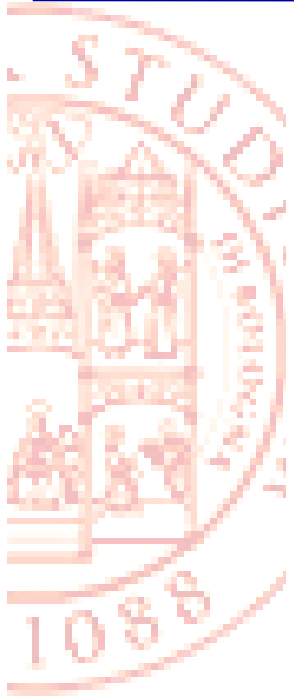
Ricerca circonferenza di best-fit



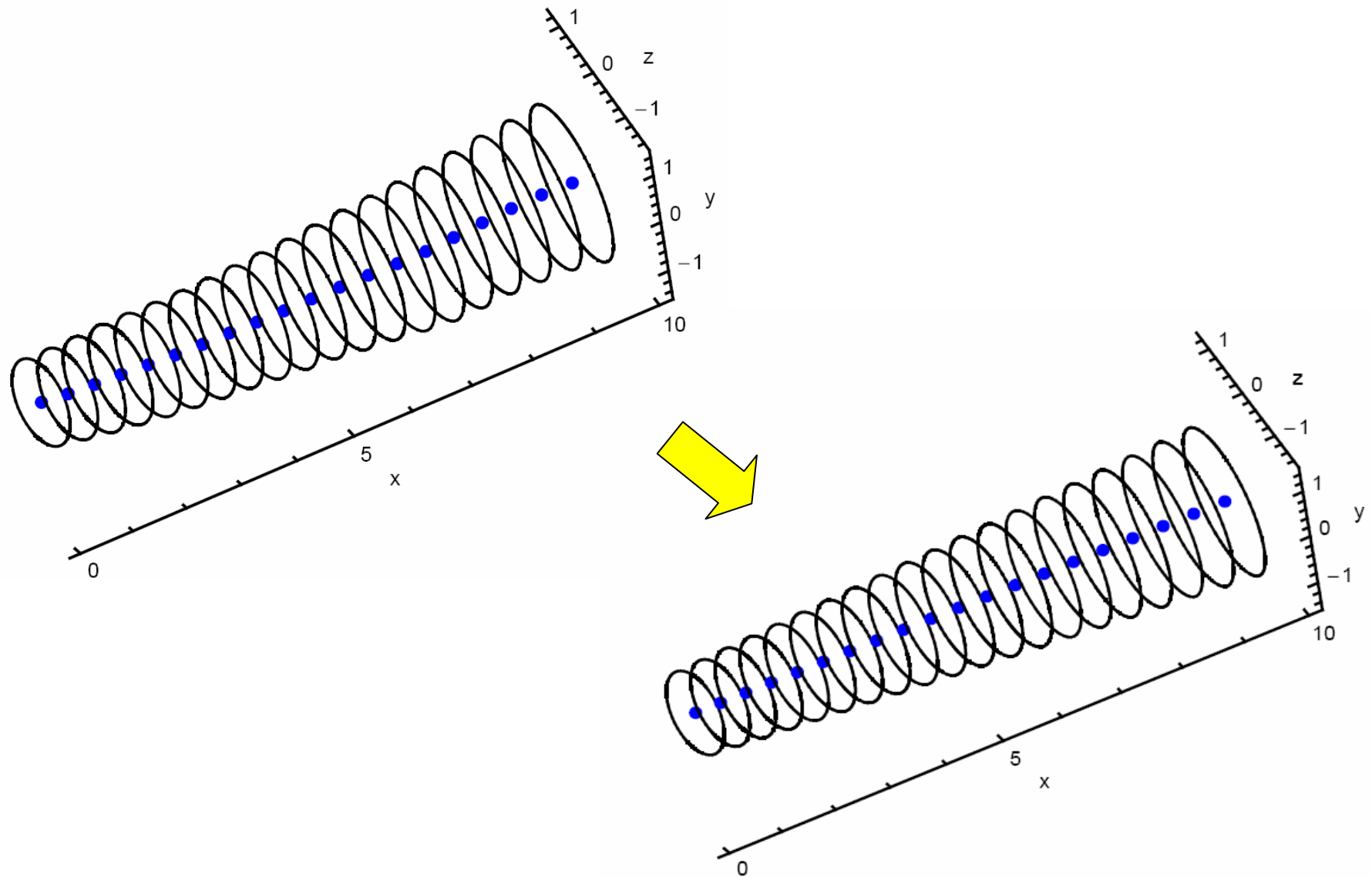
Circonferenze di best-fit



Retta di regressione dei centri

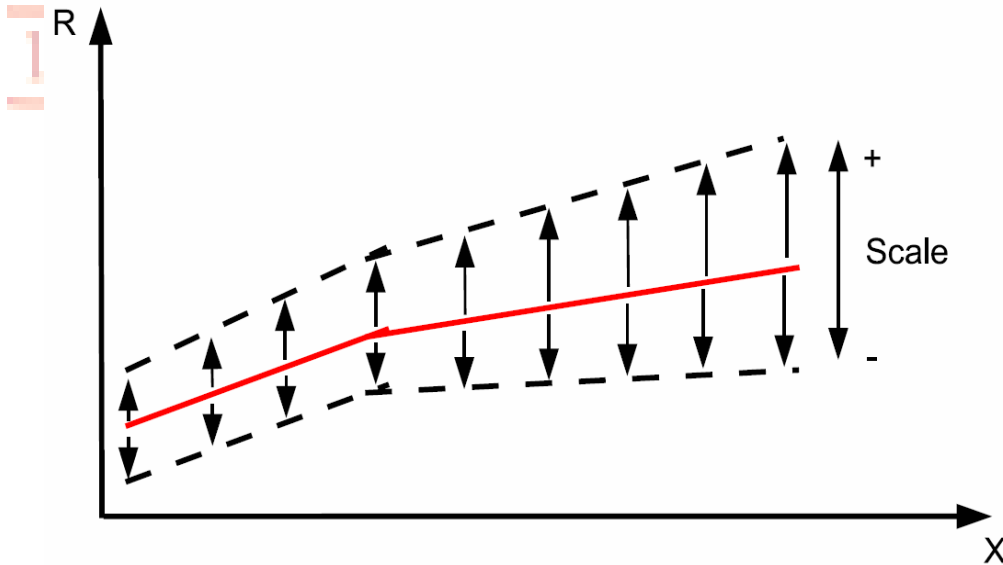
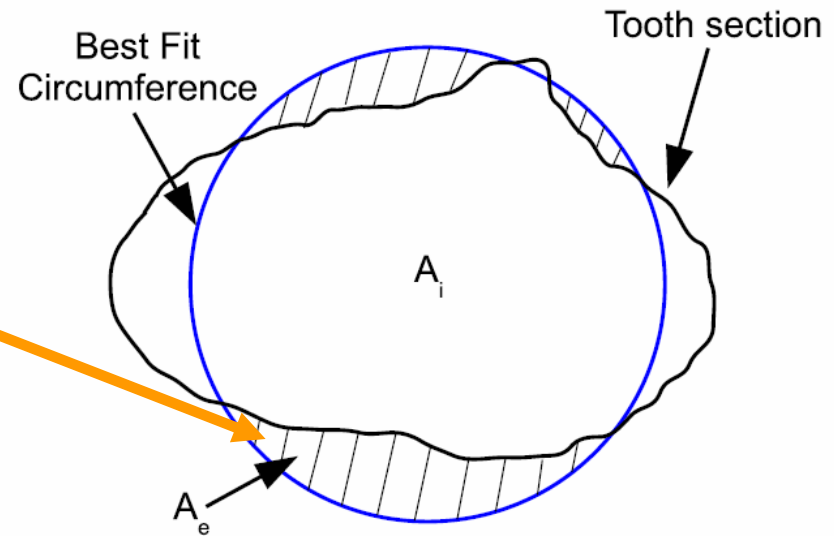


Traslazione circonferenze di best-fit sulla retta di regressione



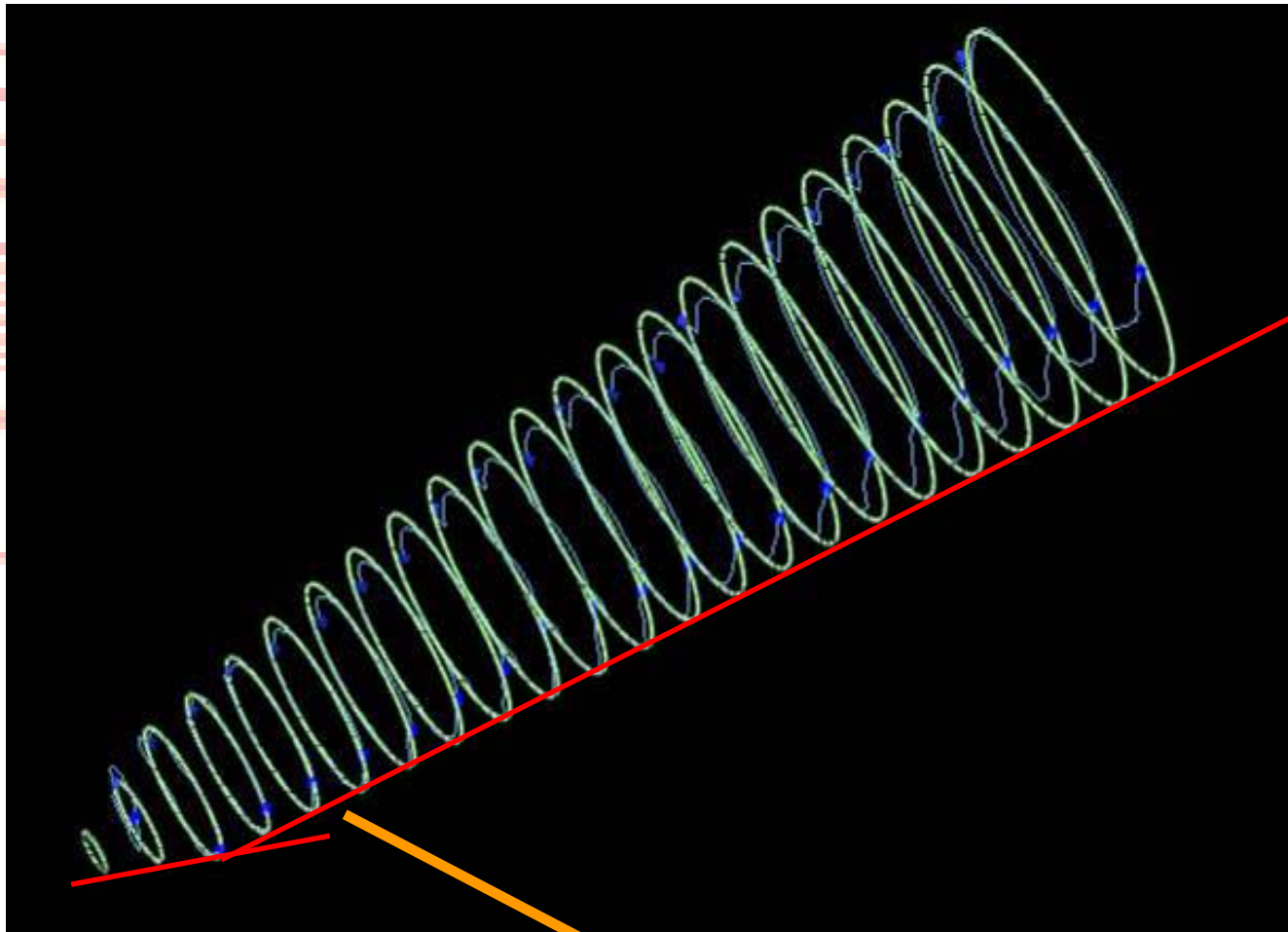
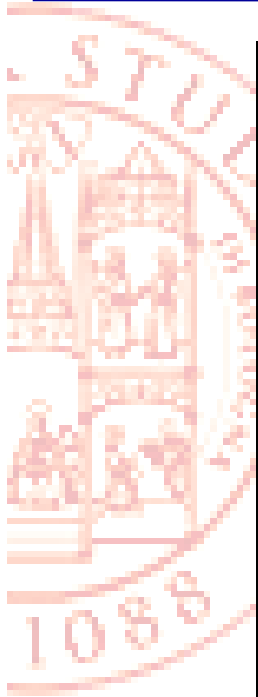
Scalatura diametri

- > Scalatura diametri
- > Vincolo sul volume asportato (entro il 10%)



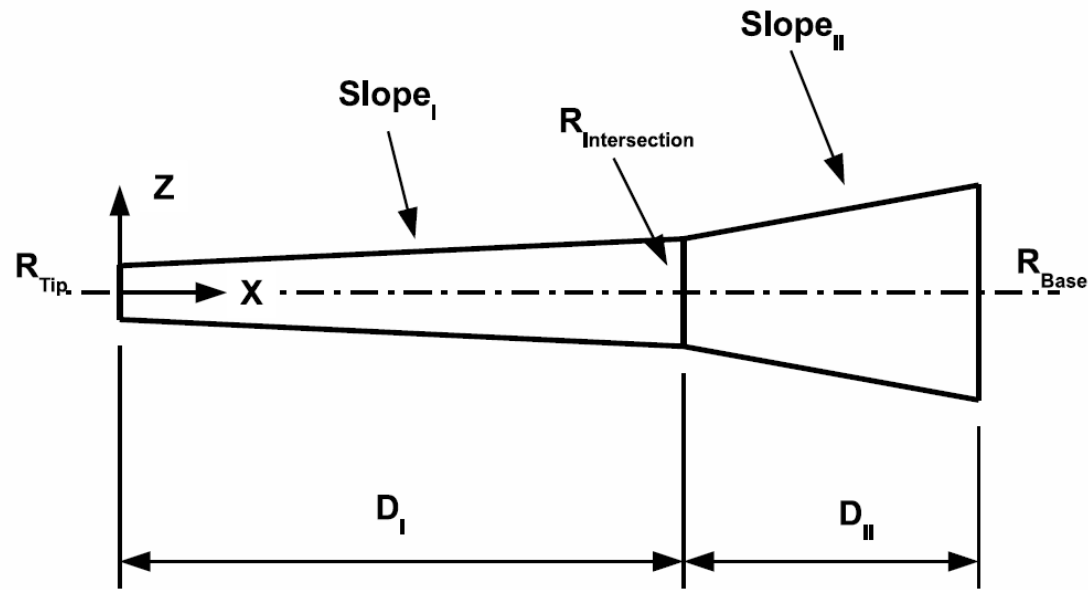
$$M_r = \frac{\sum_{j=0}^N A_e(j)}{\sum_{j=0}^N A_i(j)}$$

La forma ottimale del perno



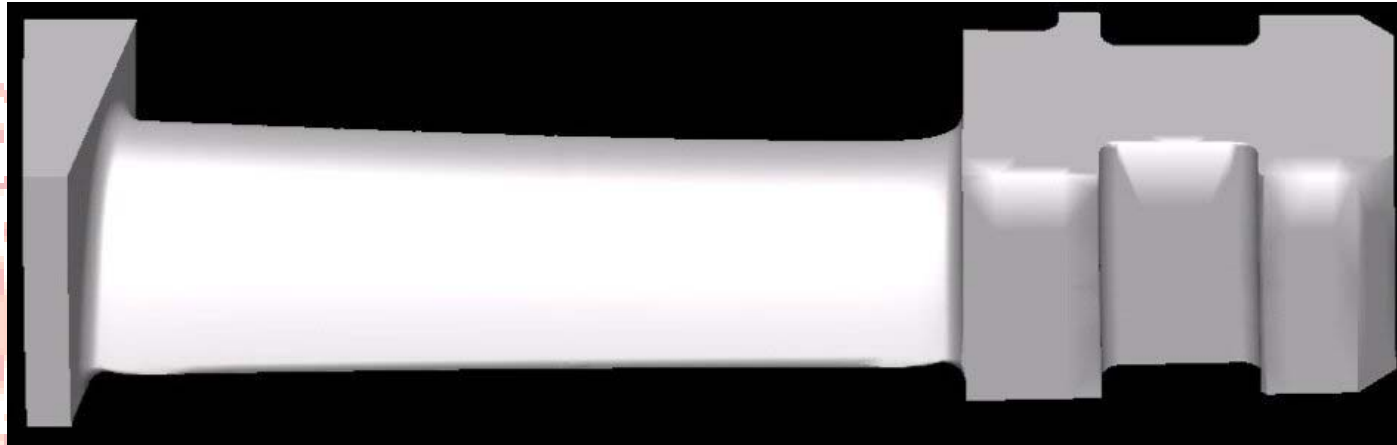
Doppia conicità

Results

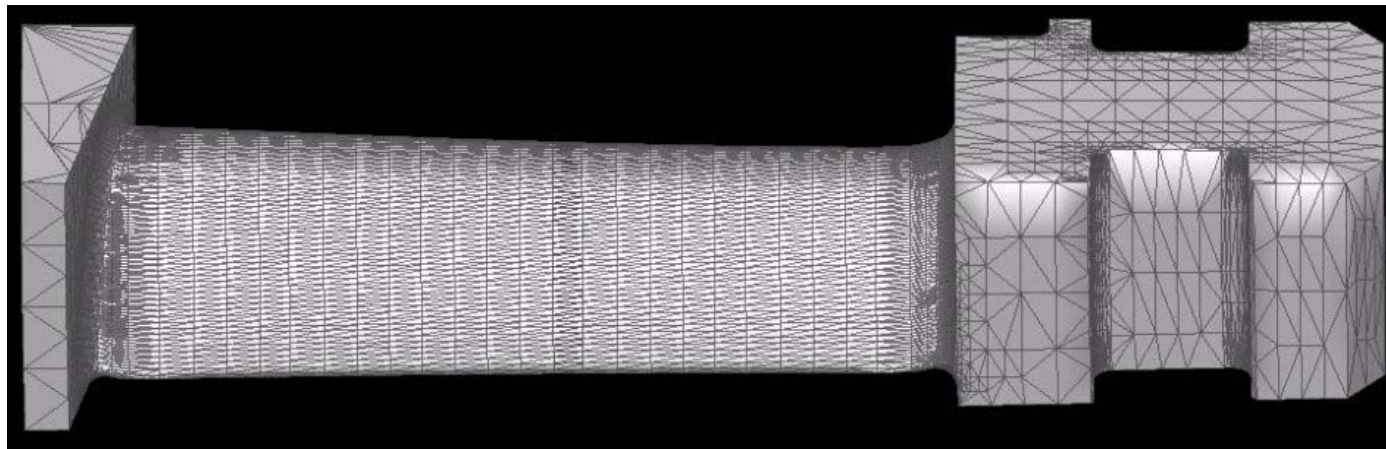


| Type | N | Feature | Measured |
|-------------------|-----------|-----------|----------|
| Commercial | | | |
| FPI | 8 | Rtip | 0.6960 |
| | 0.9 – 1.0 | | |
| | | Rbase | 1.2031 |
| | | 1.5 – 1.8 | |

Algoritmo modulo “pala OpenScan”: dati input

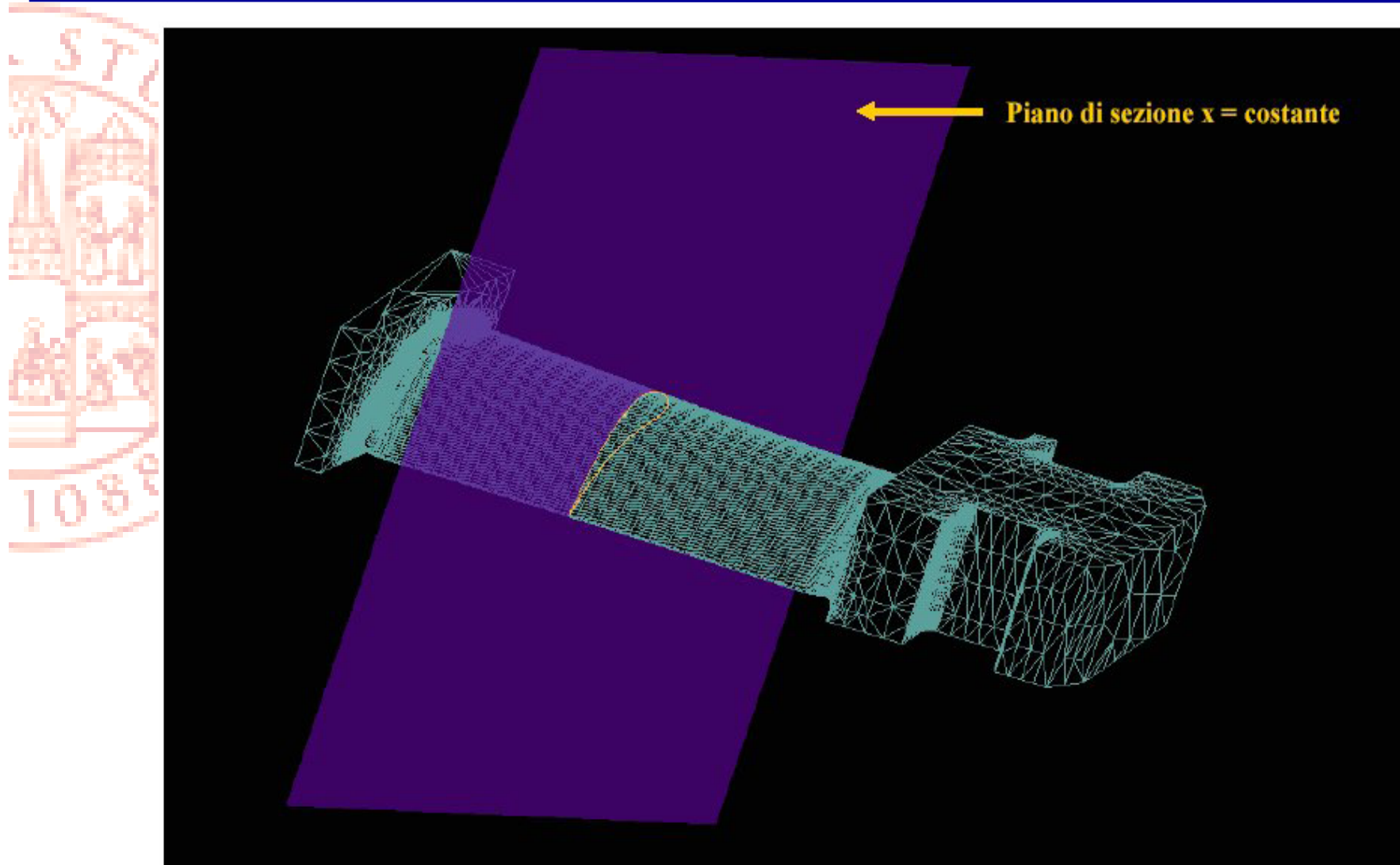


Superficie della pala

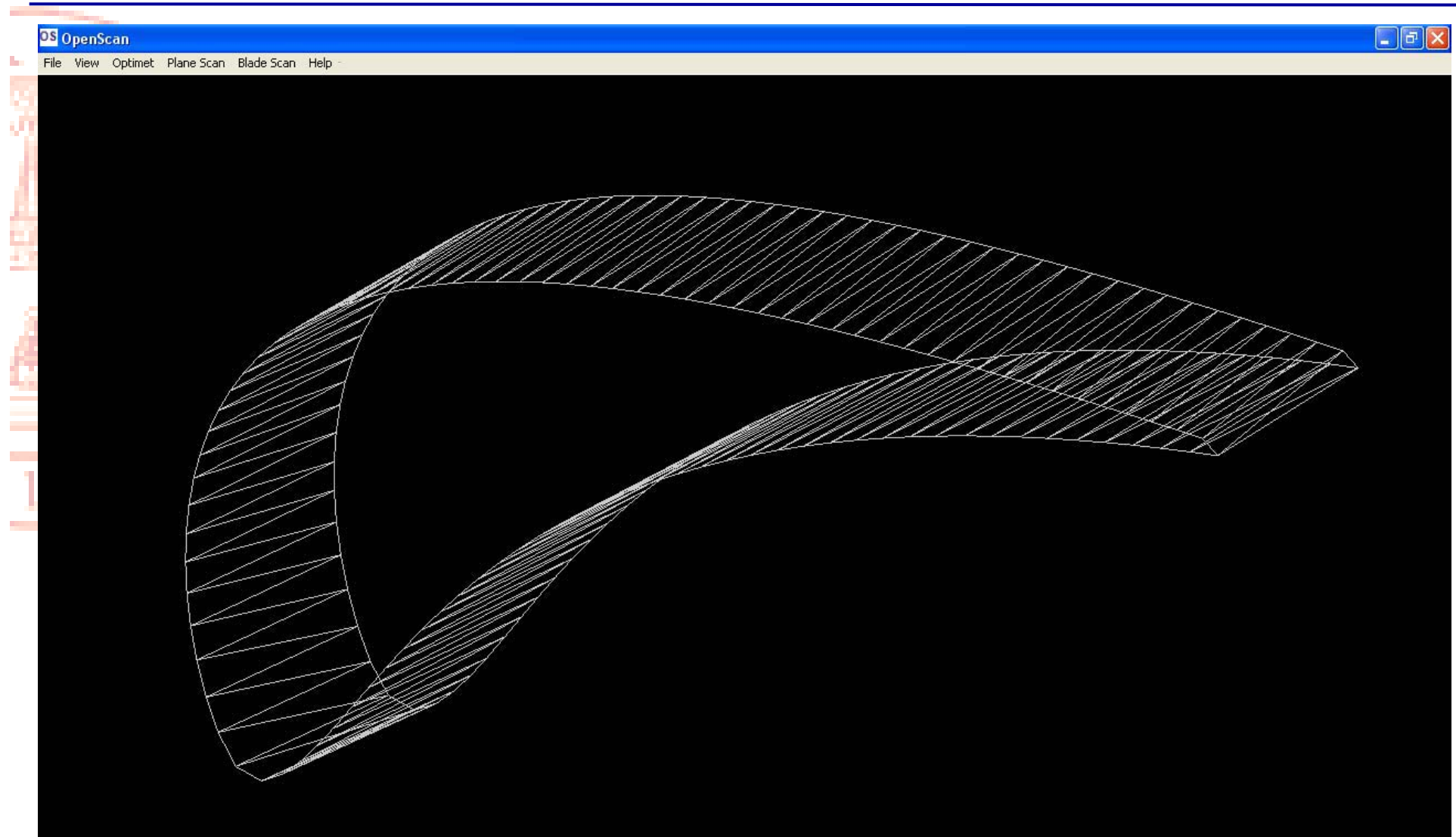


Triangolazione (file *.stl)

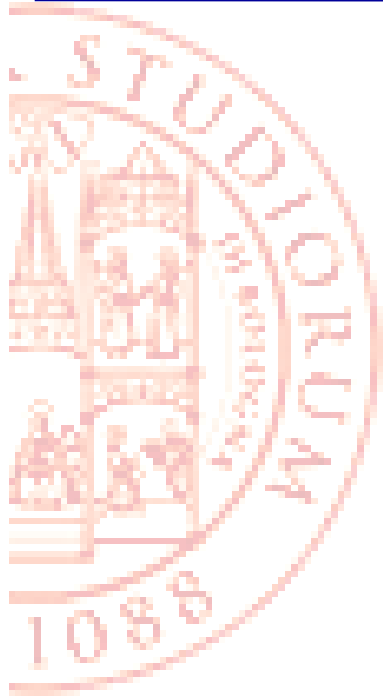
Sezionamento della pala



Determinazioni triangoli intersecati

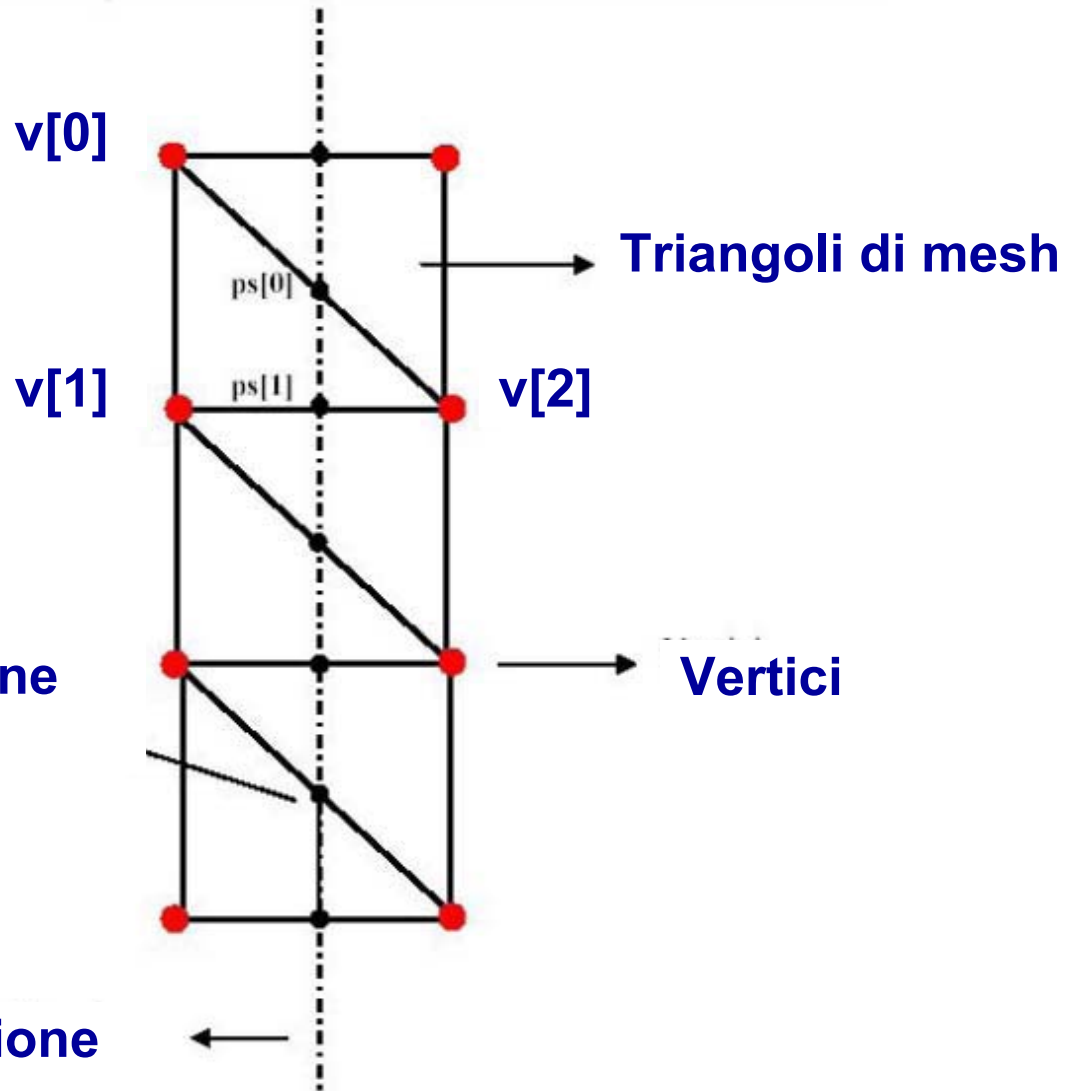


Determinazioni punti di intersezione e relativi segmenti

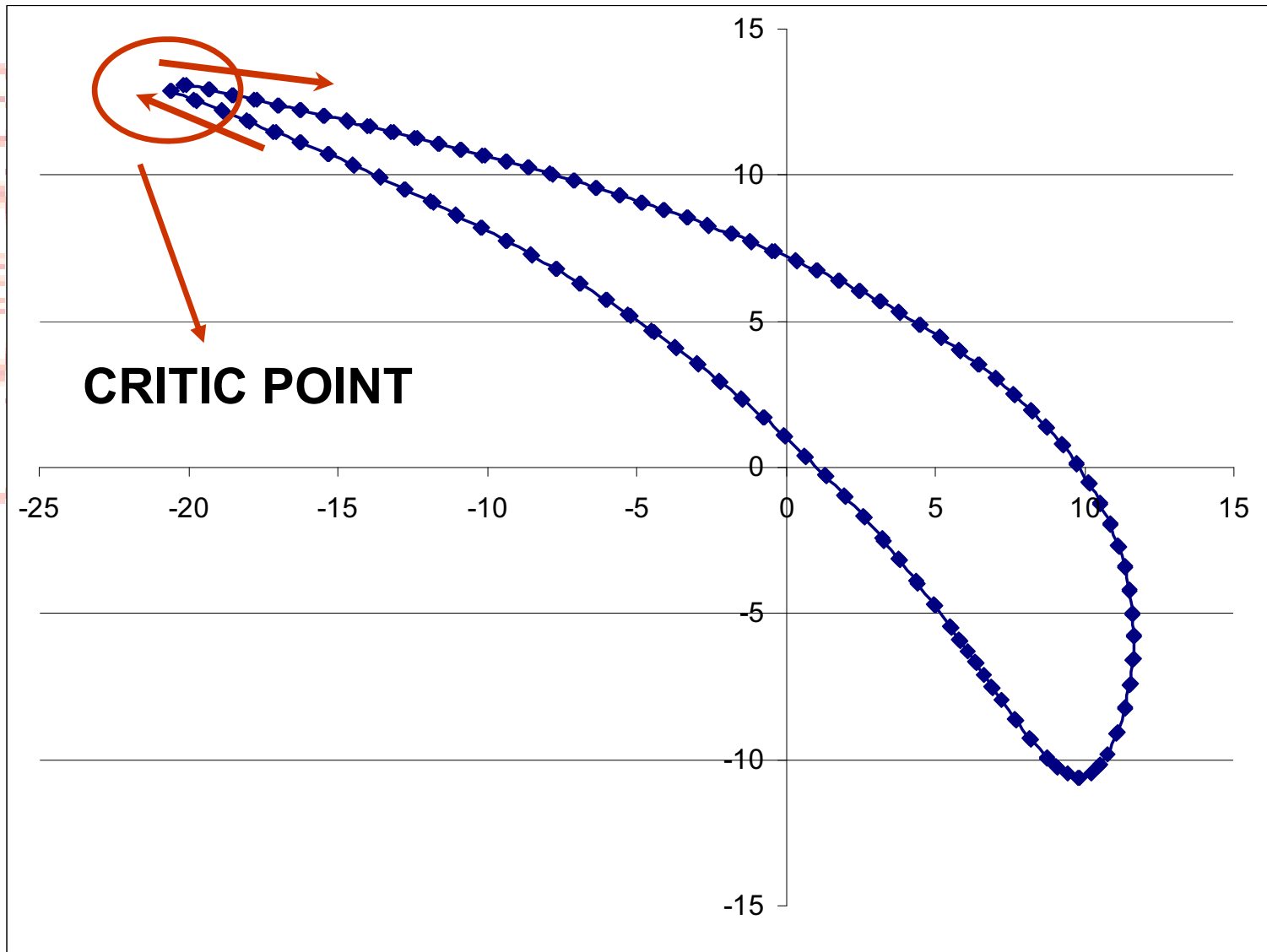
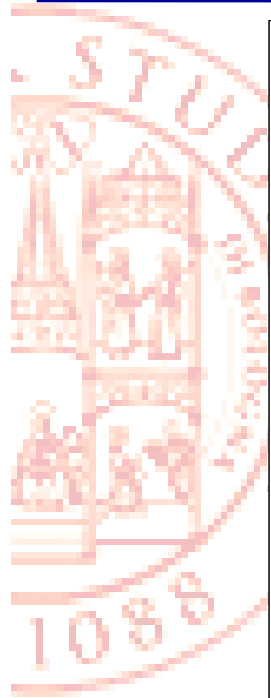


Punti di intersezione
piano -mesh

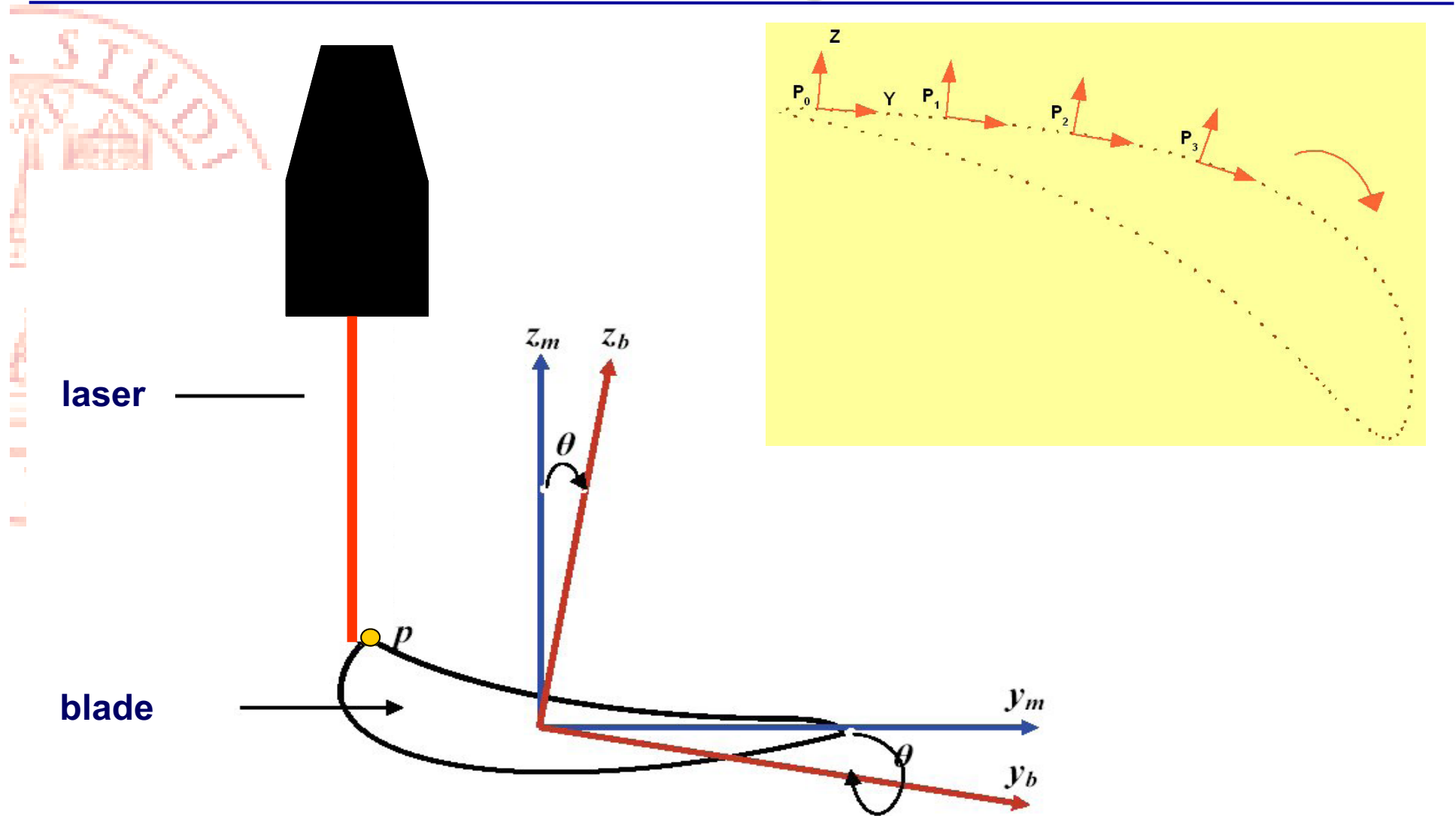
Piano di sezione



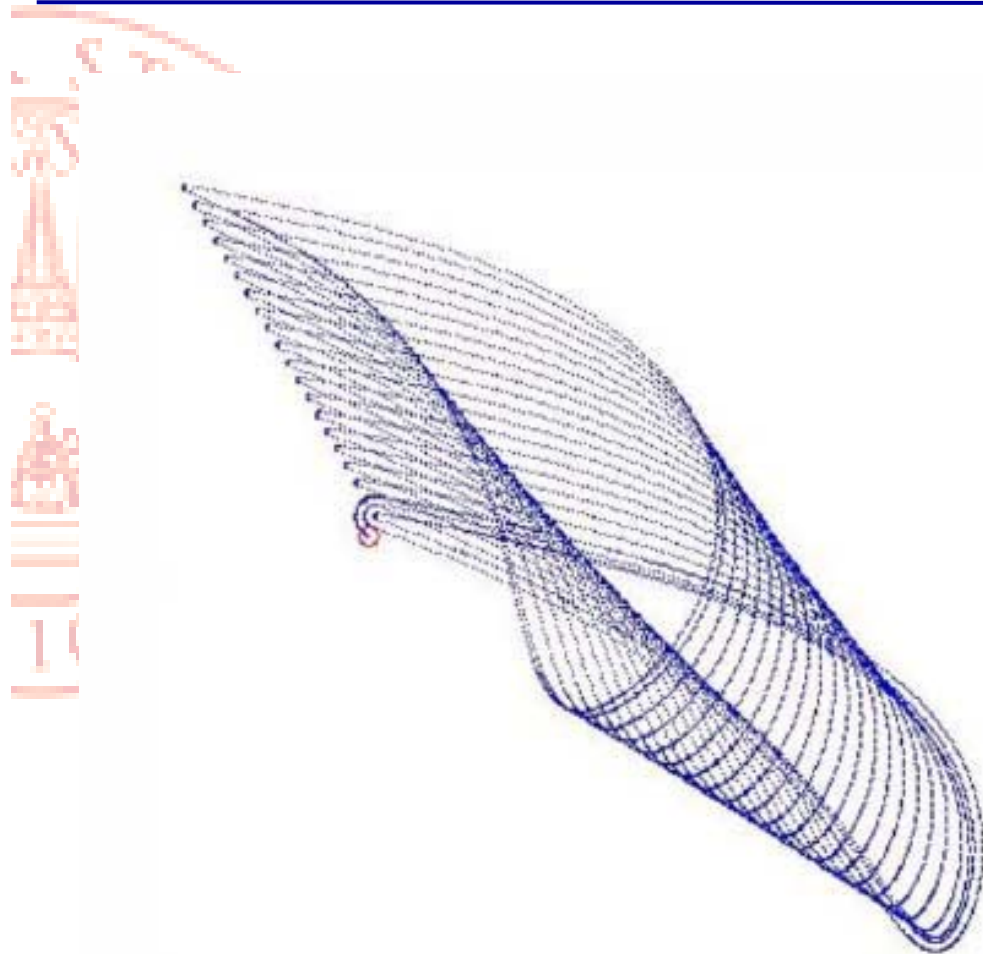
Ordinamento segmenti e determinazione punto critico



Generazione automatica part-program

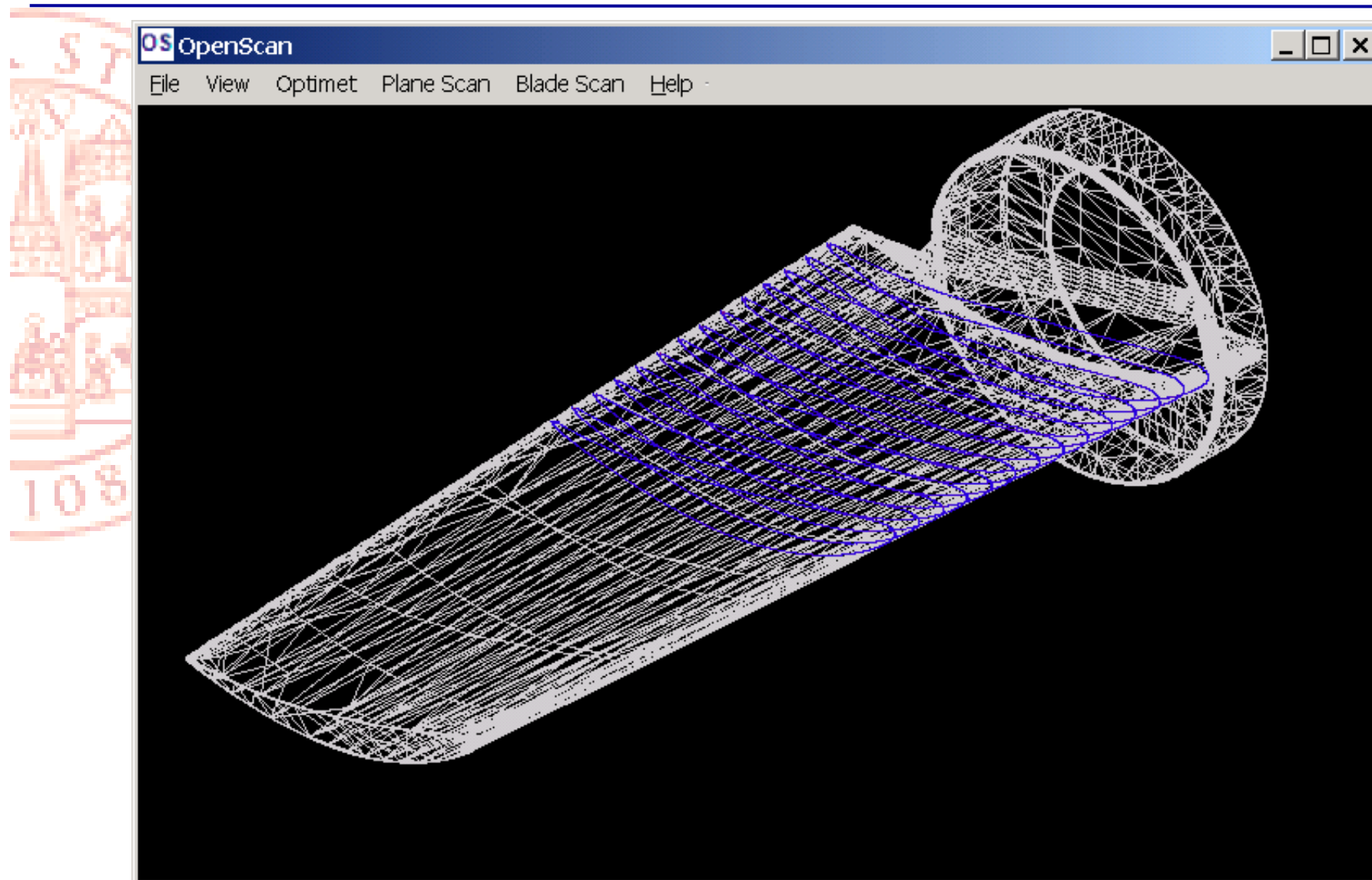


Part-program

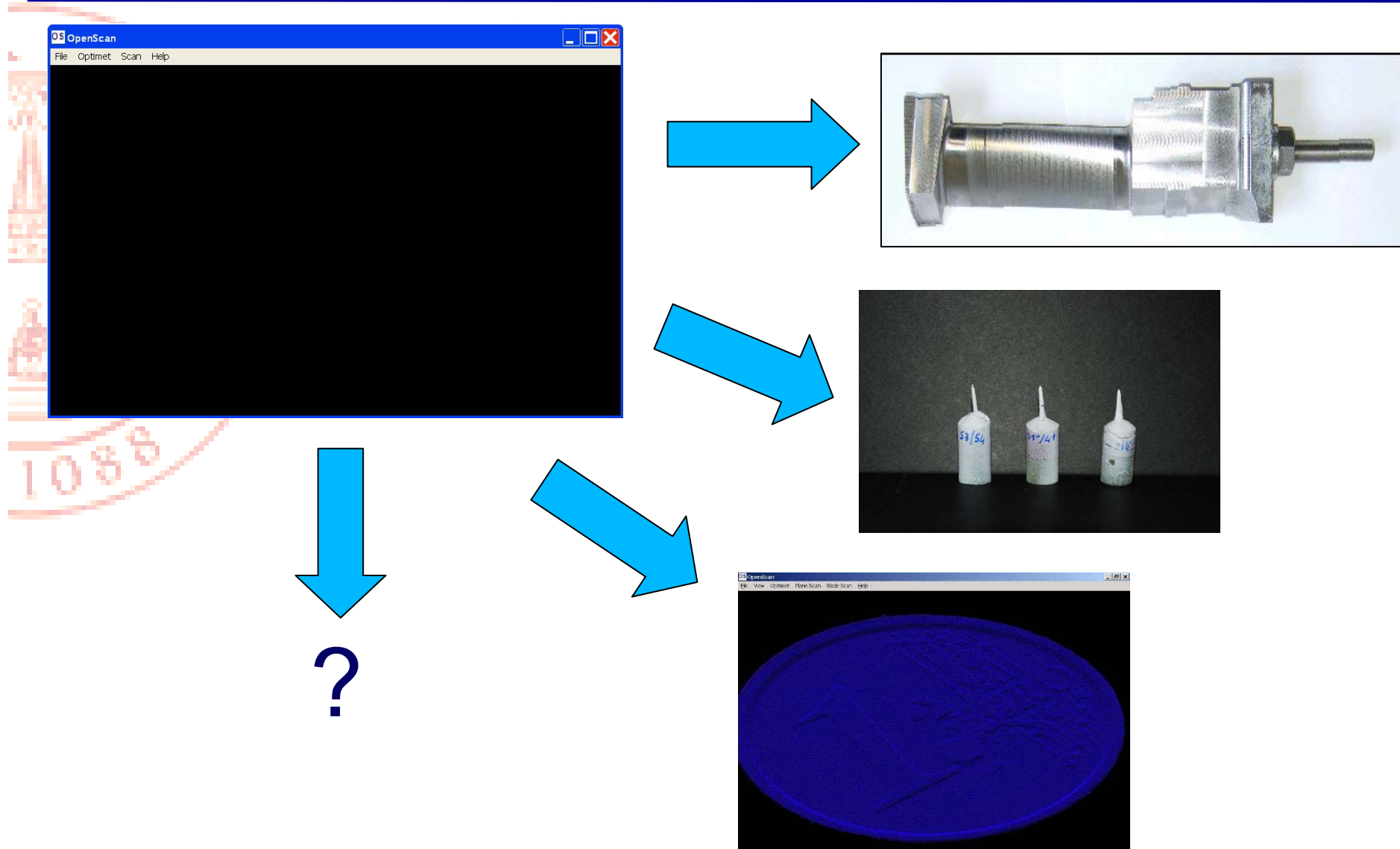


```
N10 G99 M11{XYZ}  
N20 PA1 G99  
N30 F300  
N40 G30  
N50 G0 X-0.03 Y0 Z0  
N70 G0 X-0.23 Y0 Z0  
N80 G1 X-0.03  
N90 M8100  
N100 G1 X10.07  
N110 M8101  
N120 G0 X-0.23 Y0.5 Z0  
N130 G1 X-0.03  
N140 M8100  
N150 G1 X10.07  
N160 M8101  
N170 G0 X-0.23 Y1 Z0  
N180 G1 X-0.03  
N190 M8100
```

Esecuzione automatica delle scansioni delle sezioni



OPEN: Un sistema modulare



Contatti

<http://diemtech.ing.unibo.it/>

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