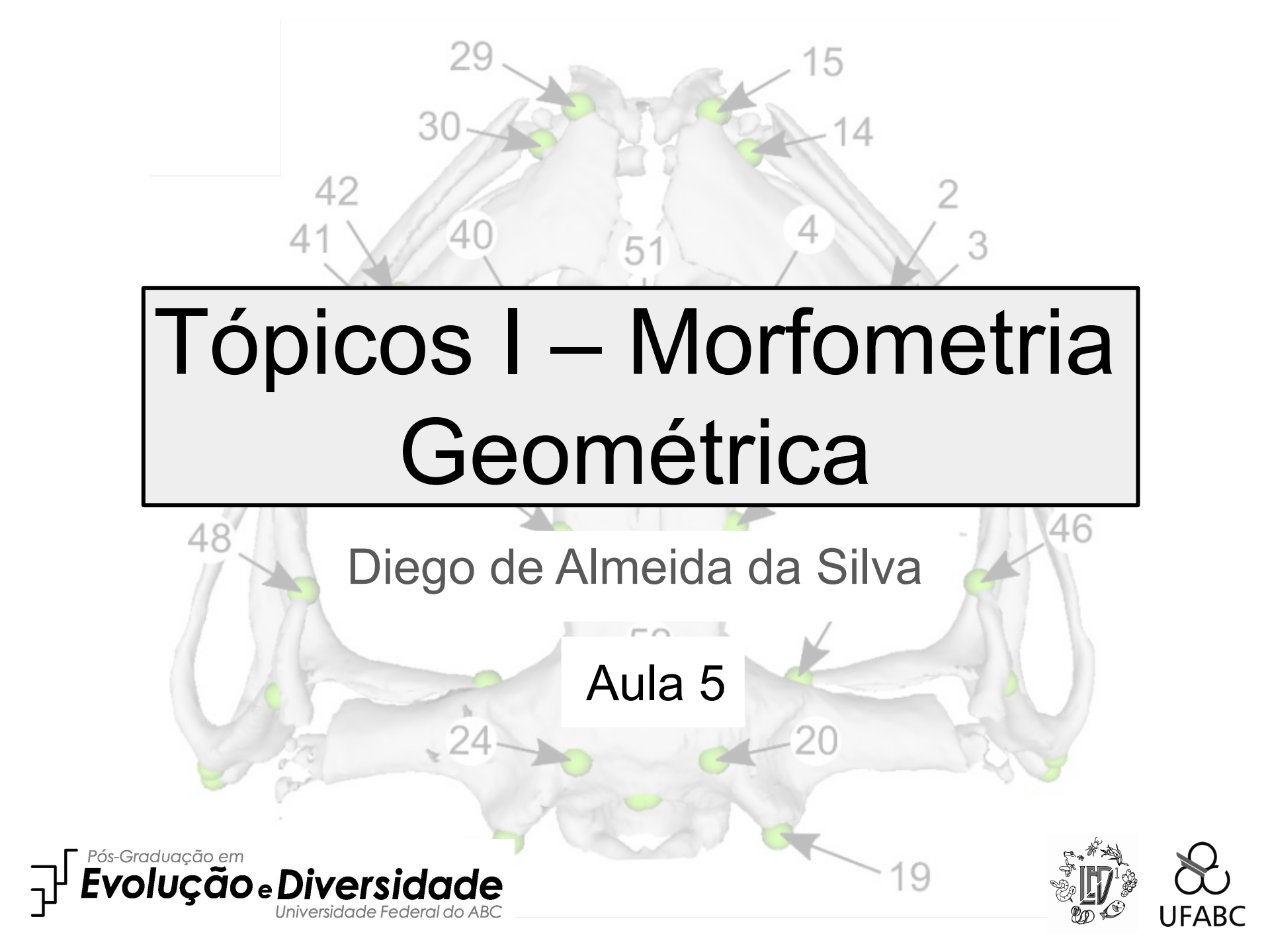


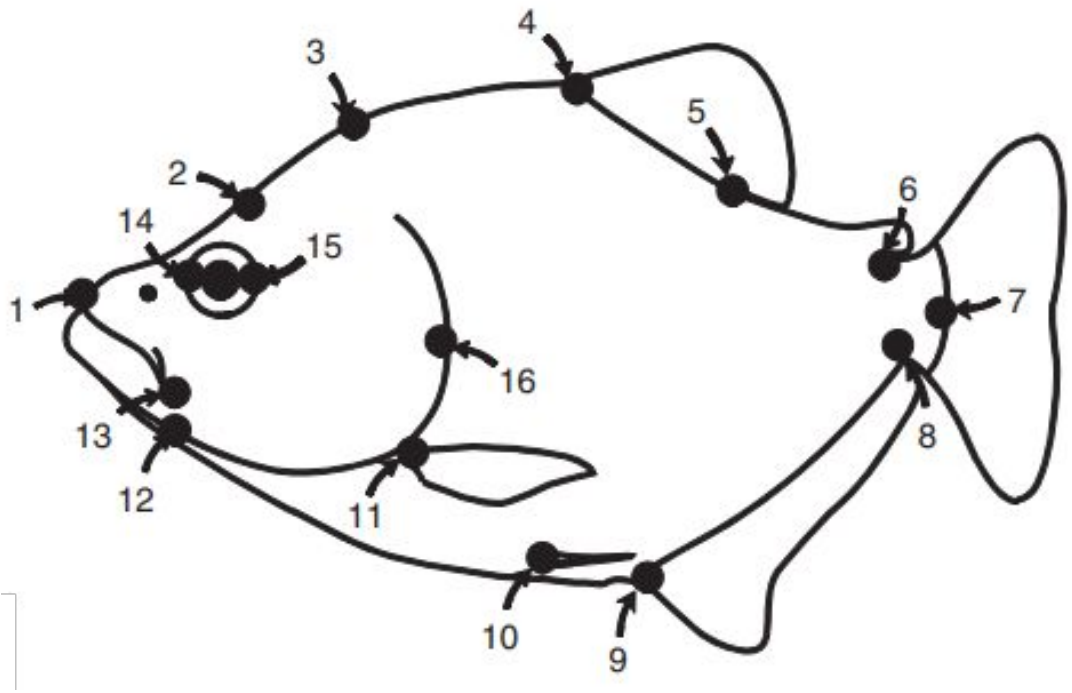
Tópicos I – Morfometria Geométrica

Diego de Almeida da Silva

Aula 5

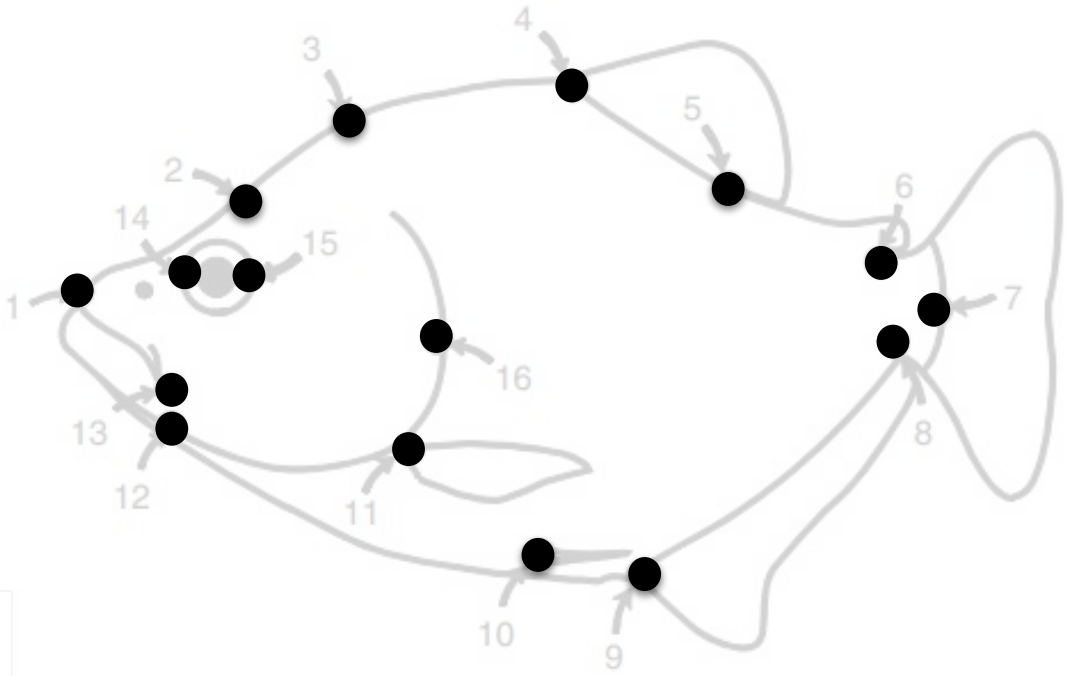
Recapitulando

*Método **eficiente** em descrever a forma*



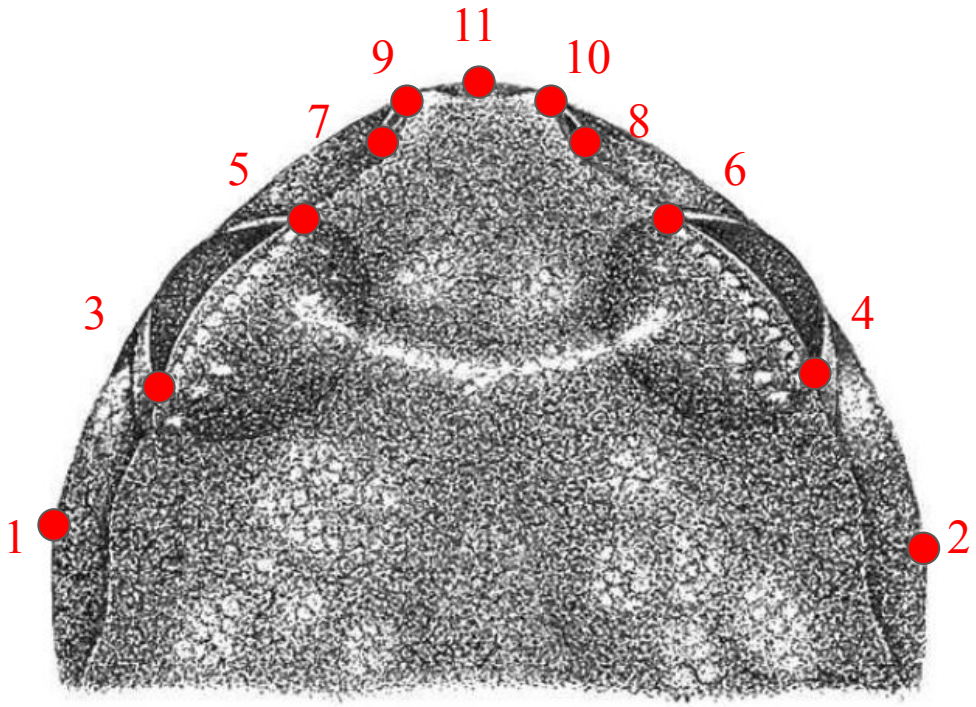
Morfometria geométrica

Recapitulando



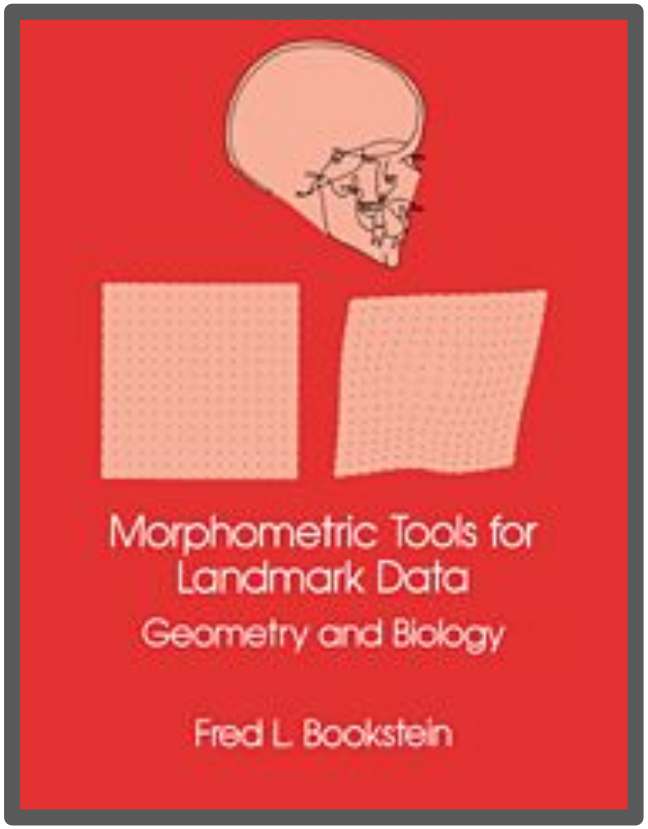
Landmarks: marcos anatômicos tomados como homólogos dentro da amostra

Landmarks



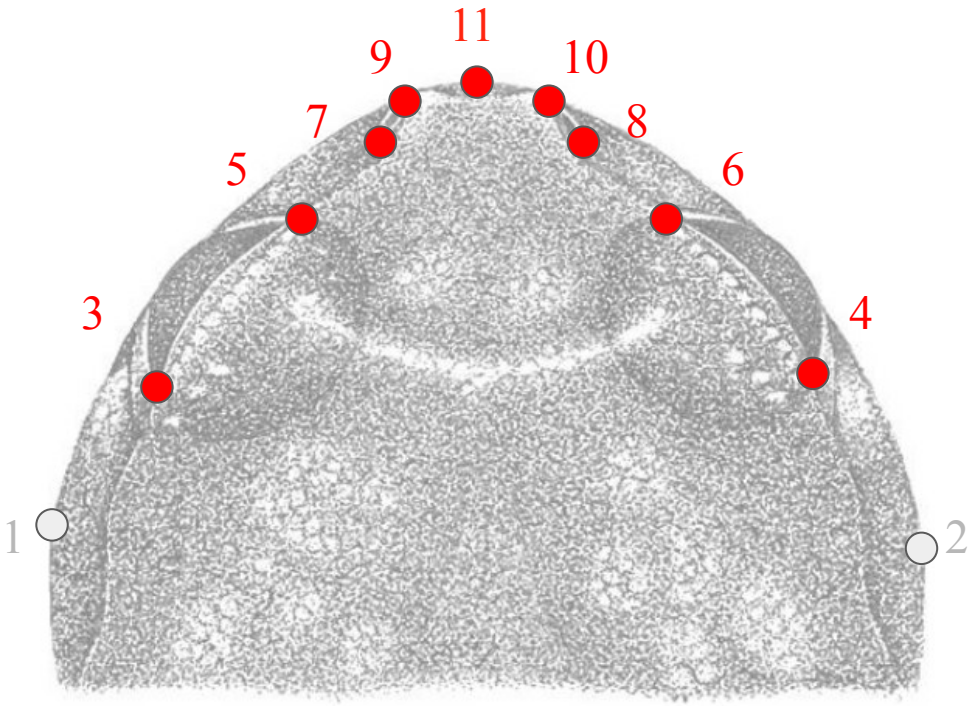
Como classificar os tipos de landmarks e qual a "qualidade" da informação anatômica transmitida

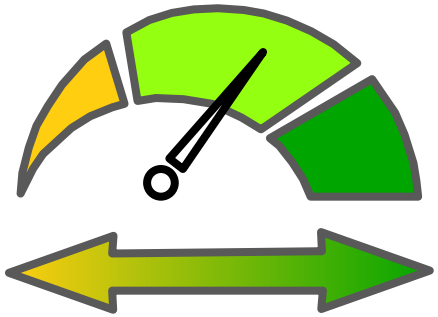
Fred. L. Bookstein



Landmarks

- *Tipo II*





Precisão Anatômica: média

Landmarks

- *Tipo II*

Pontos definidos pela geometria da estrutura, mas sem necessariamente uma característica anatômica distinta

Landmarks

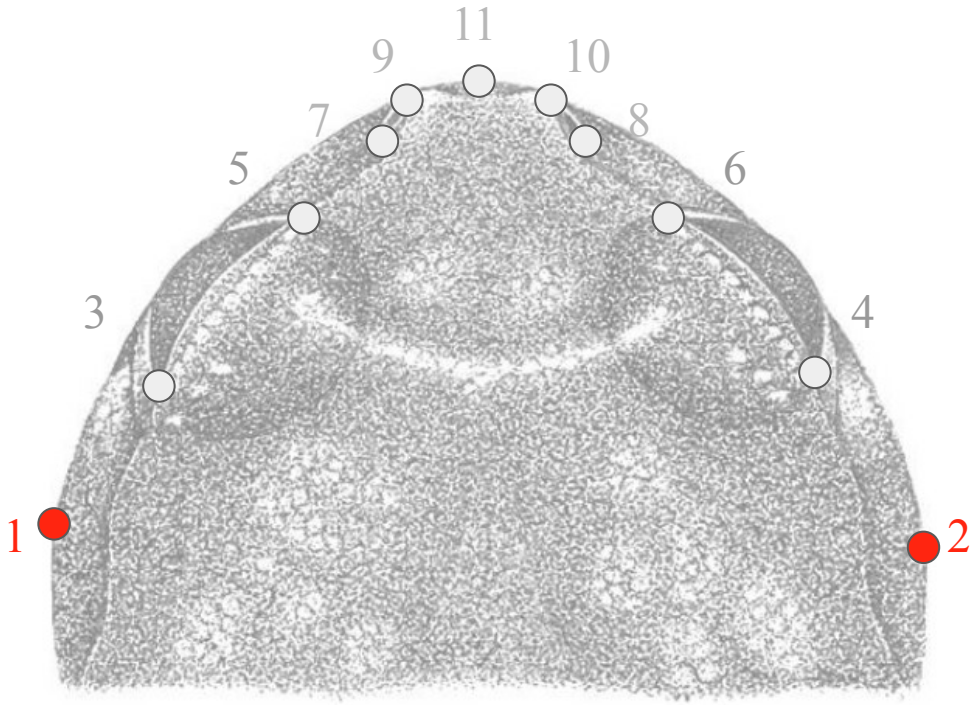
- *Tipo II*

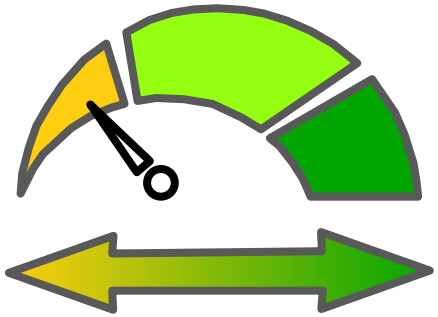
Pontos definidos pela geometria da estrutura, mas sem necessariamente uma característica anatômica distinta

E.g.: ponto mais convexo de uma curva ou o ponto mais largo de uma estrutura

Landmarks

- *Tipo III*





Precisão Anatômica: baixa

Landmarks

- *Tipo III*

Pontos de referência com localização arbitrária ou de difícil identificação precisa, com significado anatômico limitado

Landmarks

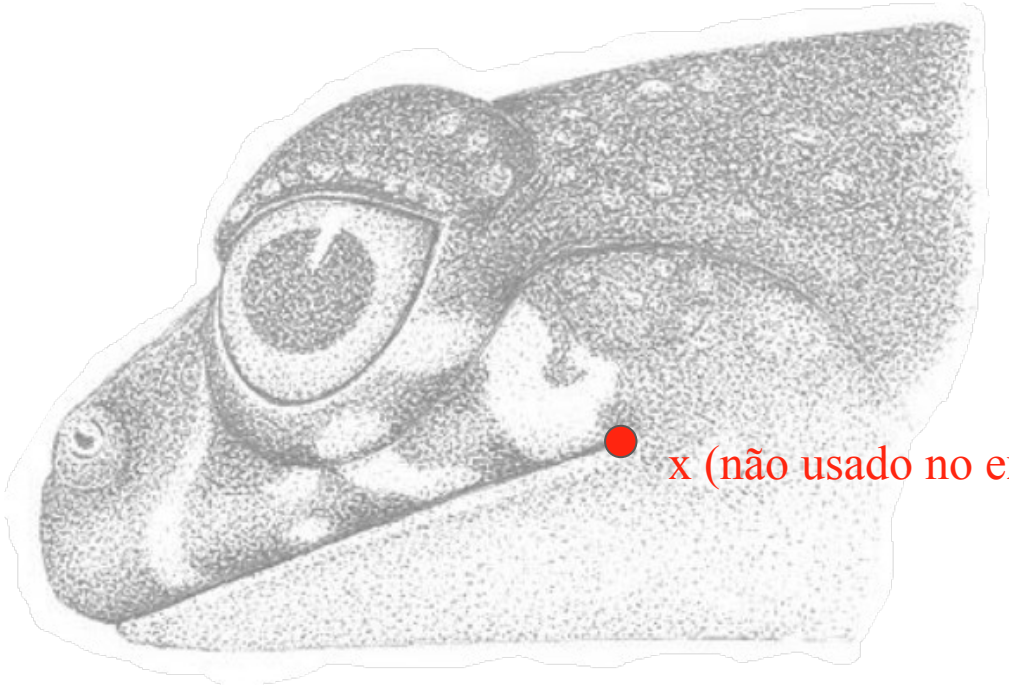
- *Tipo III*

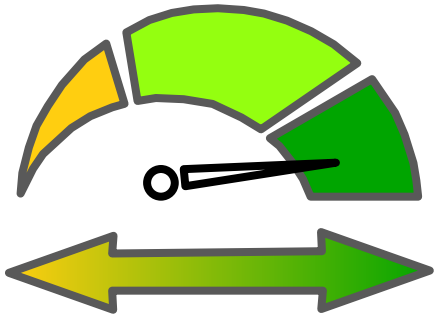
Pontos de referência com localização arbitrária ou de difícil identificação precisa, com significado anatômico limitado

E.g.: ponto no meio de uma superfície lisa, sem características anatômicas marcantes

Landmarks

- *Tipo I*





Precisão Anatômica: alta

Landmarks

- *Tipo I*

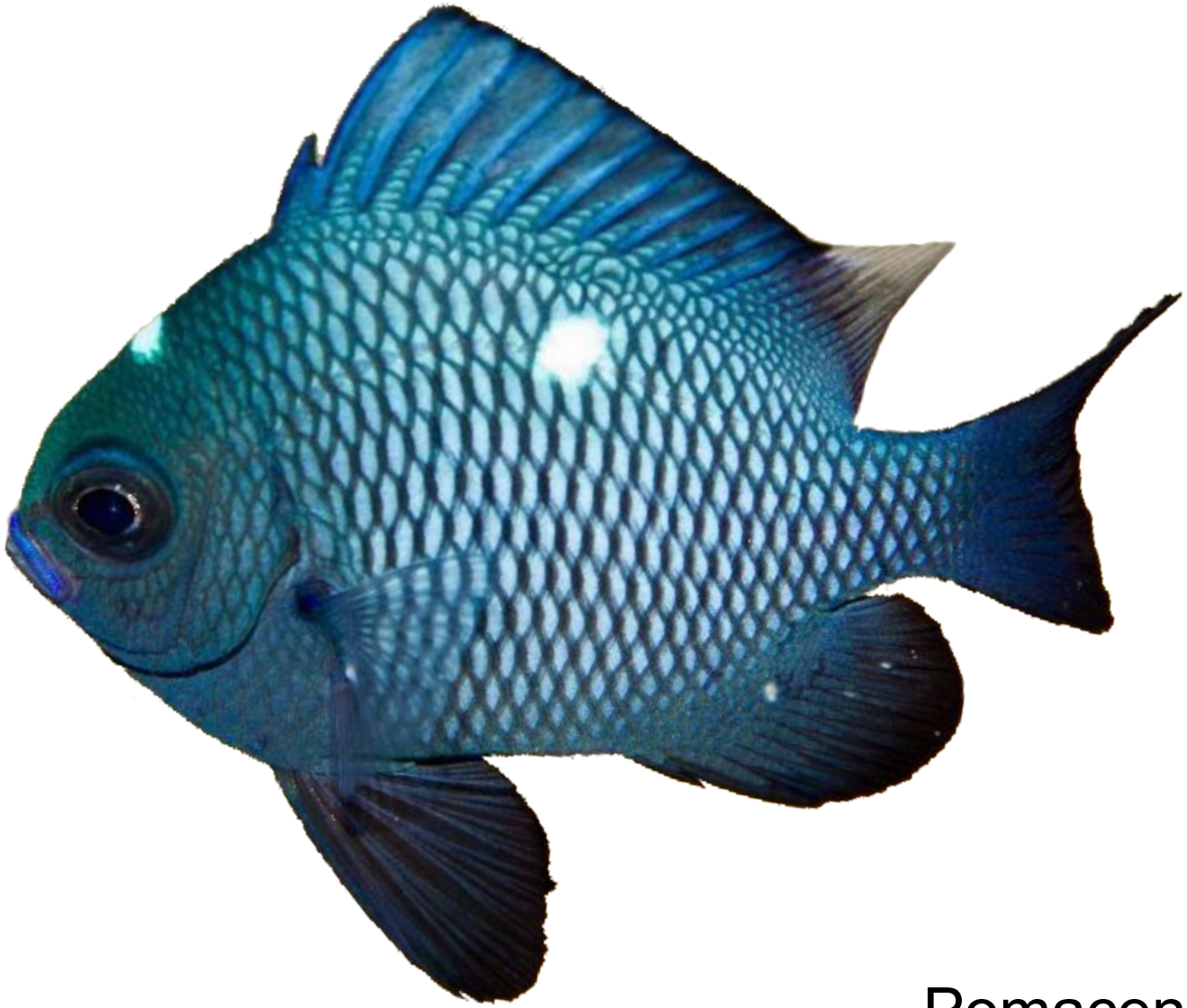
Pontos anatômicos fixos, com significado biológico claro e bem definido

Landmarks

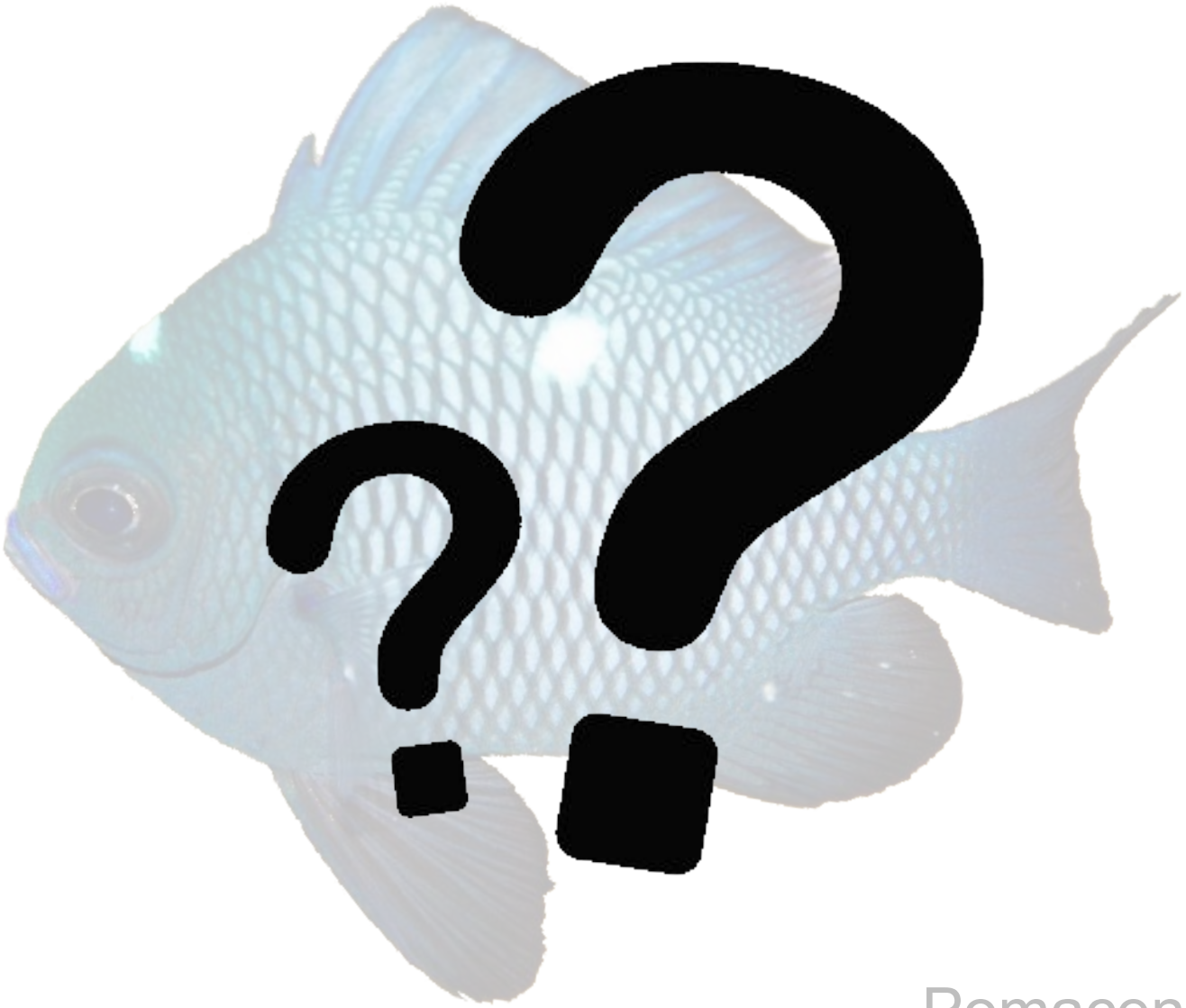
- *Tipo I*

Pontos anatômicos fixos, com significado biológico claro e bem definido

E.g.: interseções de suturas, junções de ossos, etc

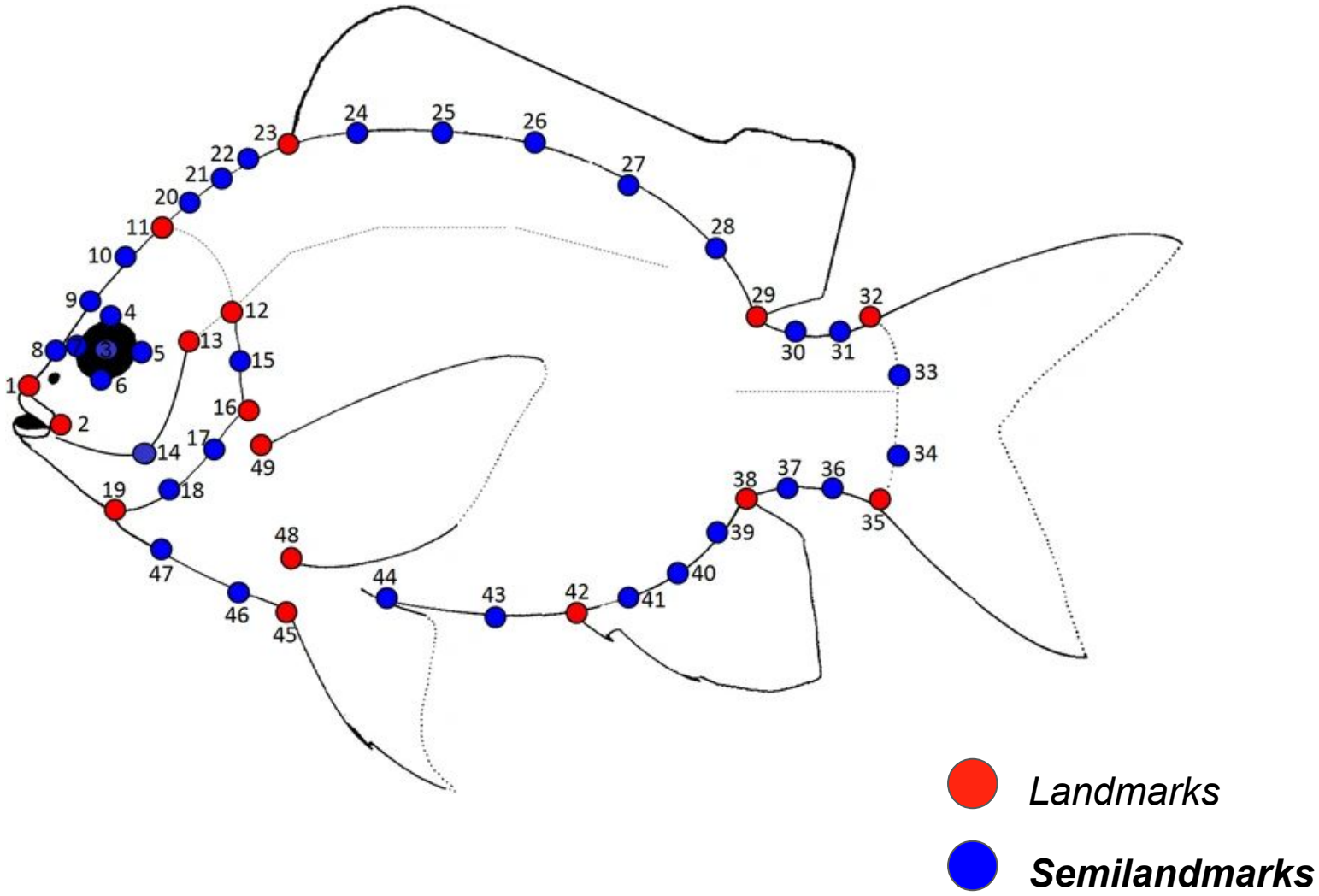


Pomacentridae



Pomacentridae

https://doi.org/10.1007/s00435-017-0391-6



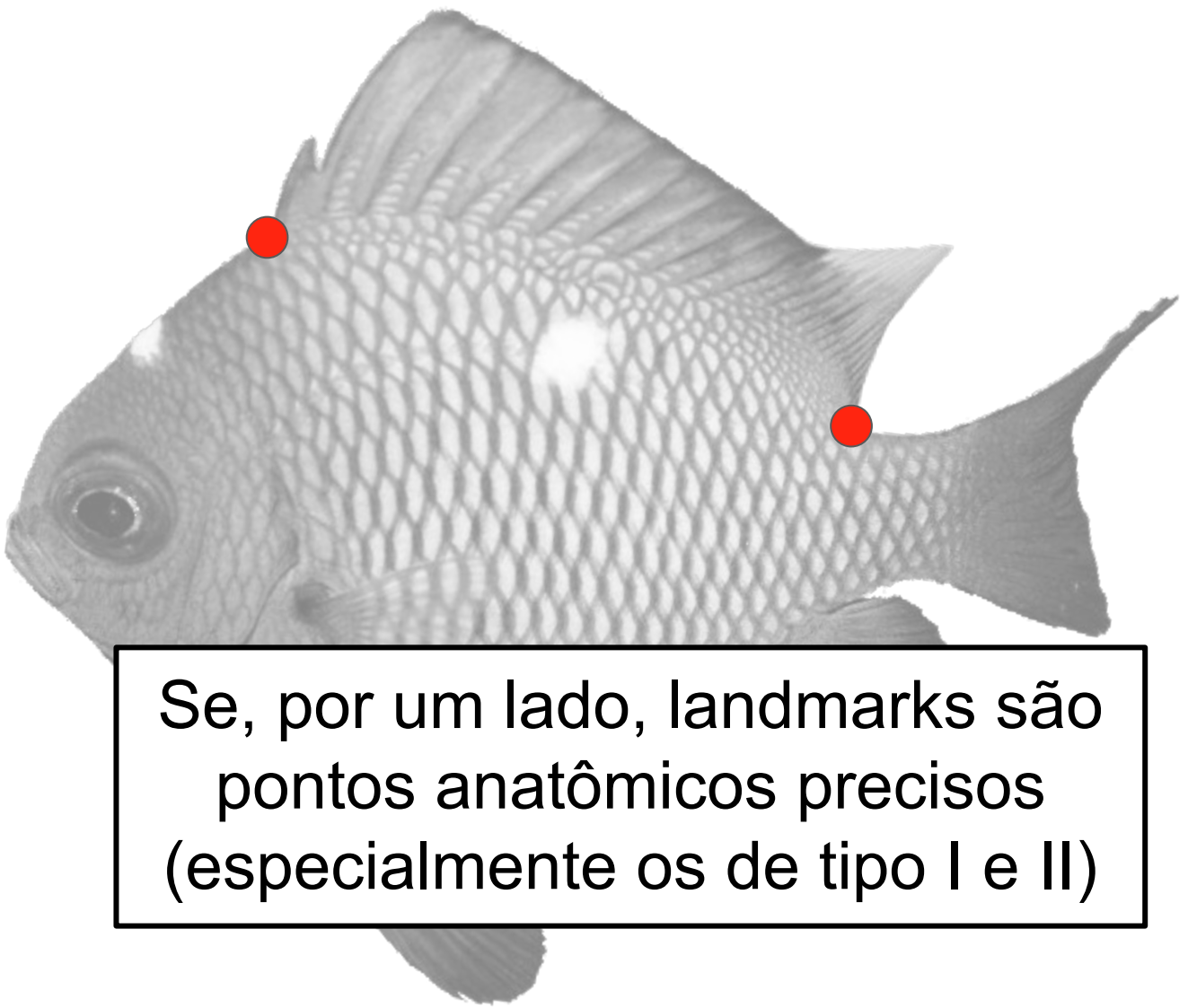
Medical Image Analysis (1996/7) volume 1, number 3, pp 225–243

Landmark methods for forms without landmarks: morphometrics of group differences in outline shape

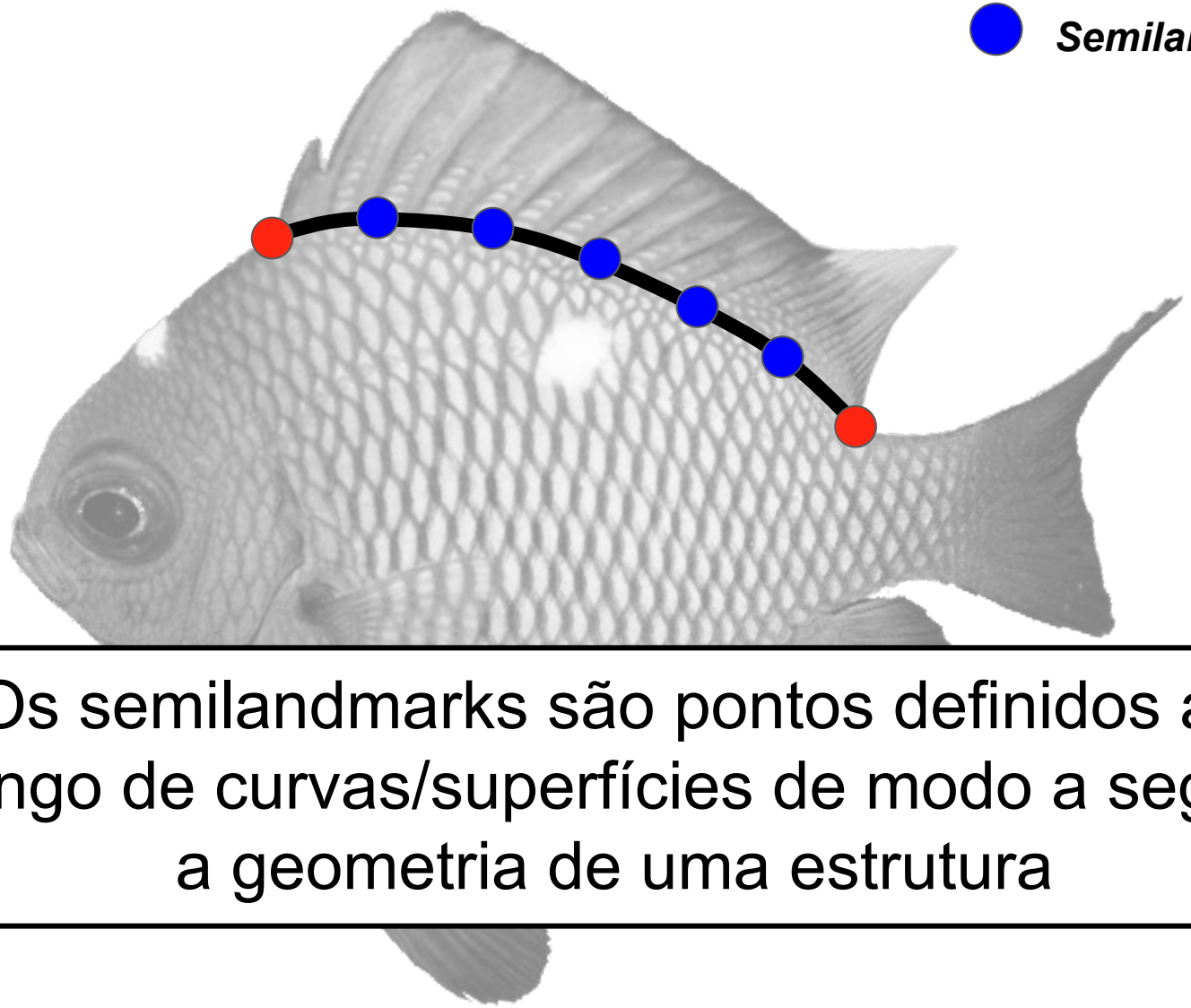
Fred L. Bookstein*

Institute of Gerontology, University of Michigan, 300 North Ingalls Building, Ann Arbor, MI 48109-2007, USA

Fred. L. Bookstein

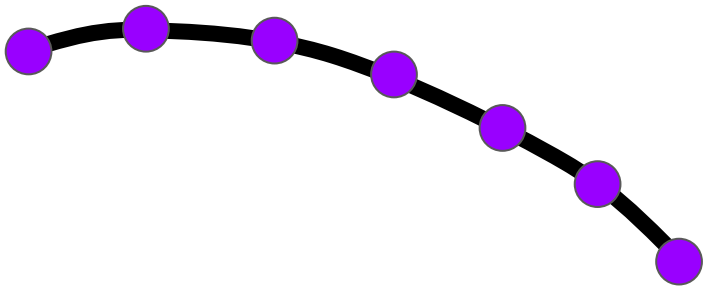


Se, por um lado, landmarks são pontos anatômicos precisos (especialmente os de tipo I e II)



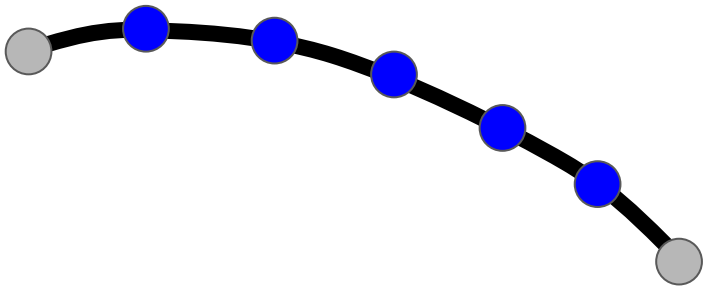
Os semilandmarks são pontos definidos ao longo de curvas/superfícies de modo a seguir a geometria de uma estrutura

Como comparar?



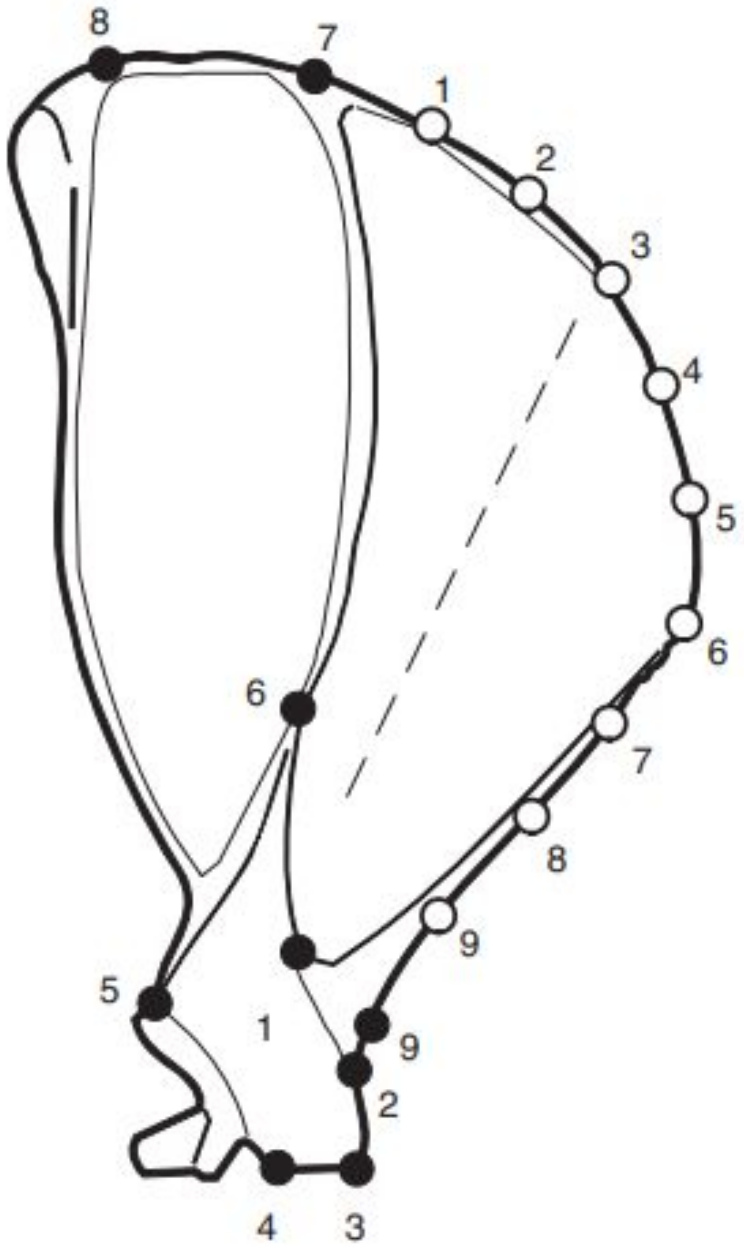
Será que todos esses pontos devem ter a mesma importância (biológica e estatística)?

Como comparar?



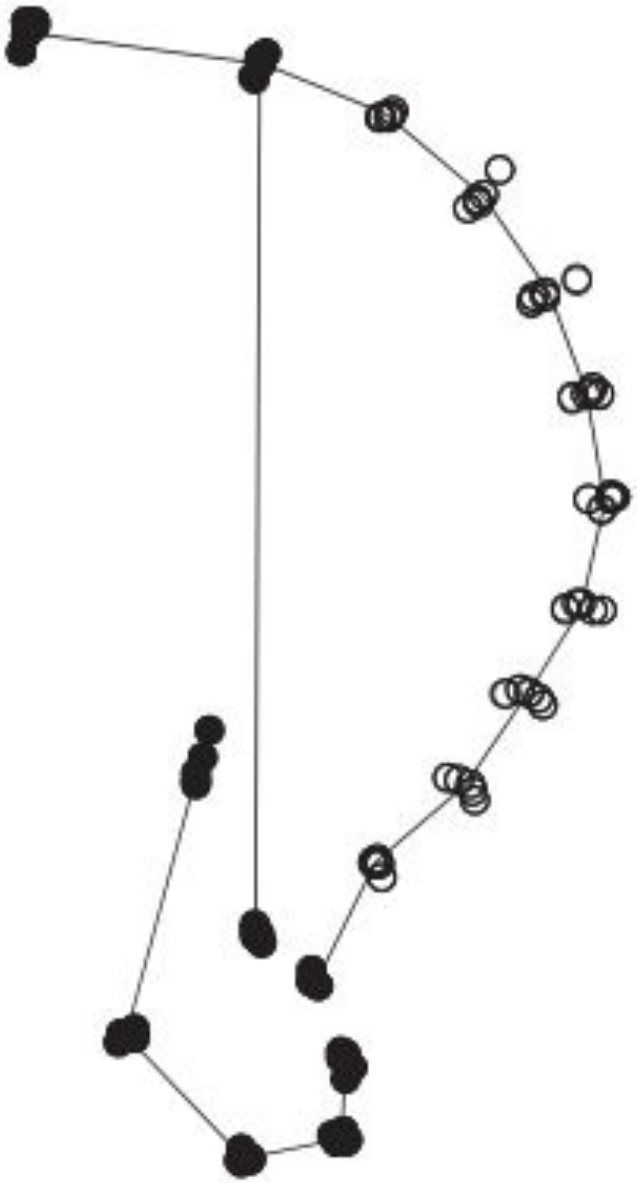
Será que todos esses pontos devem ter a mesma importância (biológica e estatística)?

Semilandmarks podem gerar mais ***ruído***



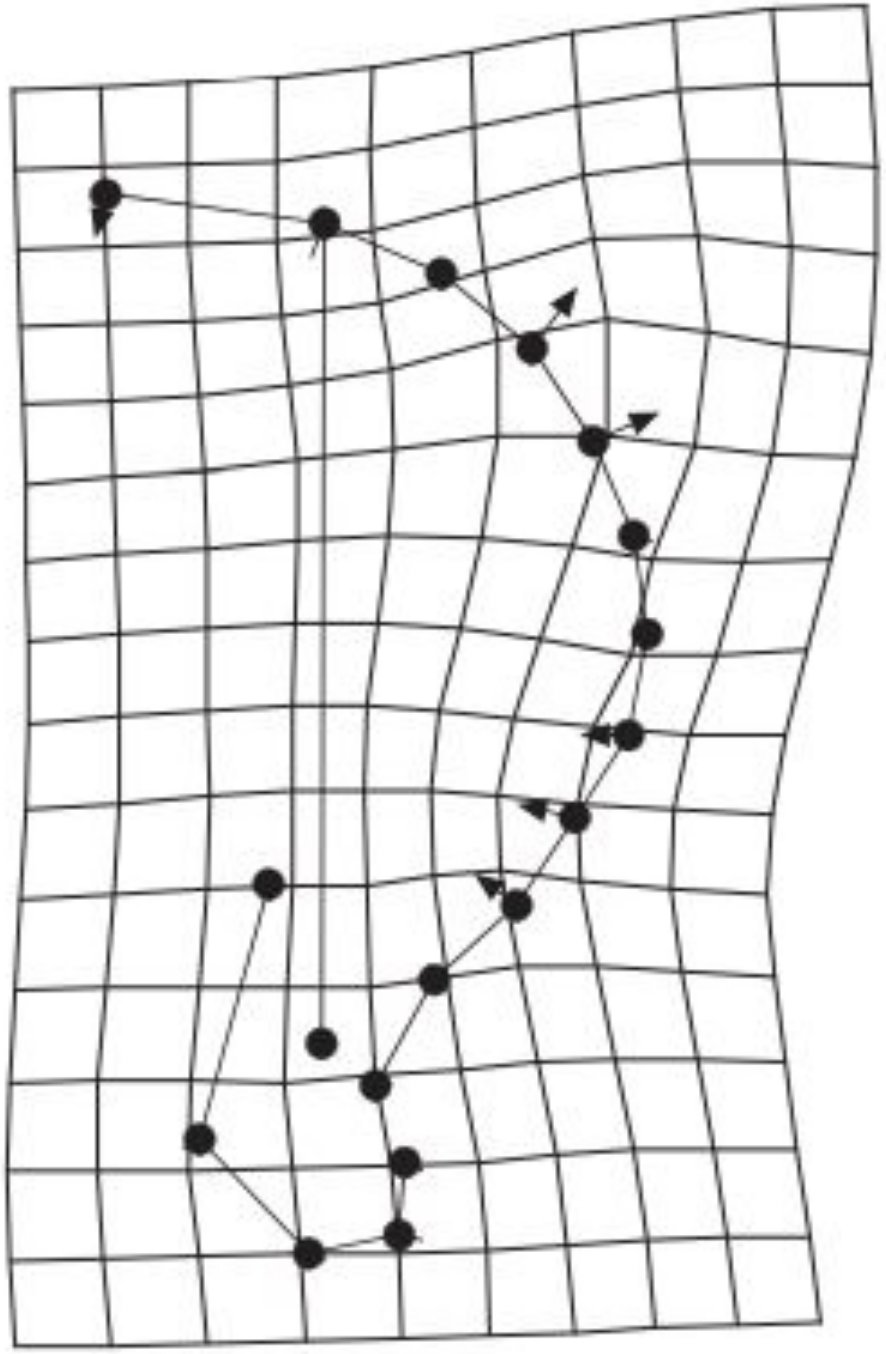
n_{land} =

$n_{semiland}$

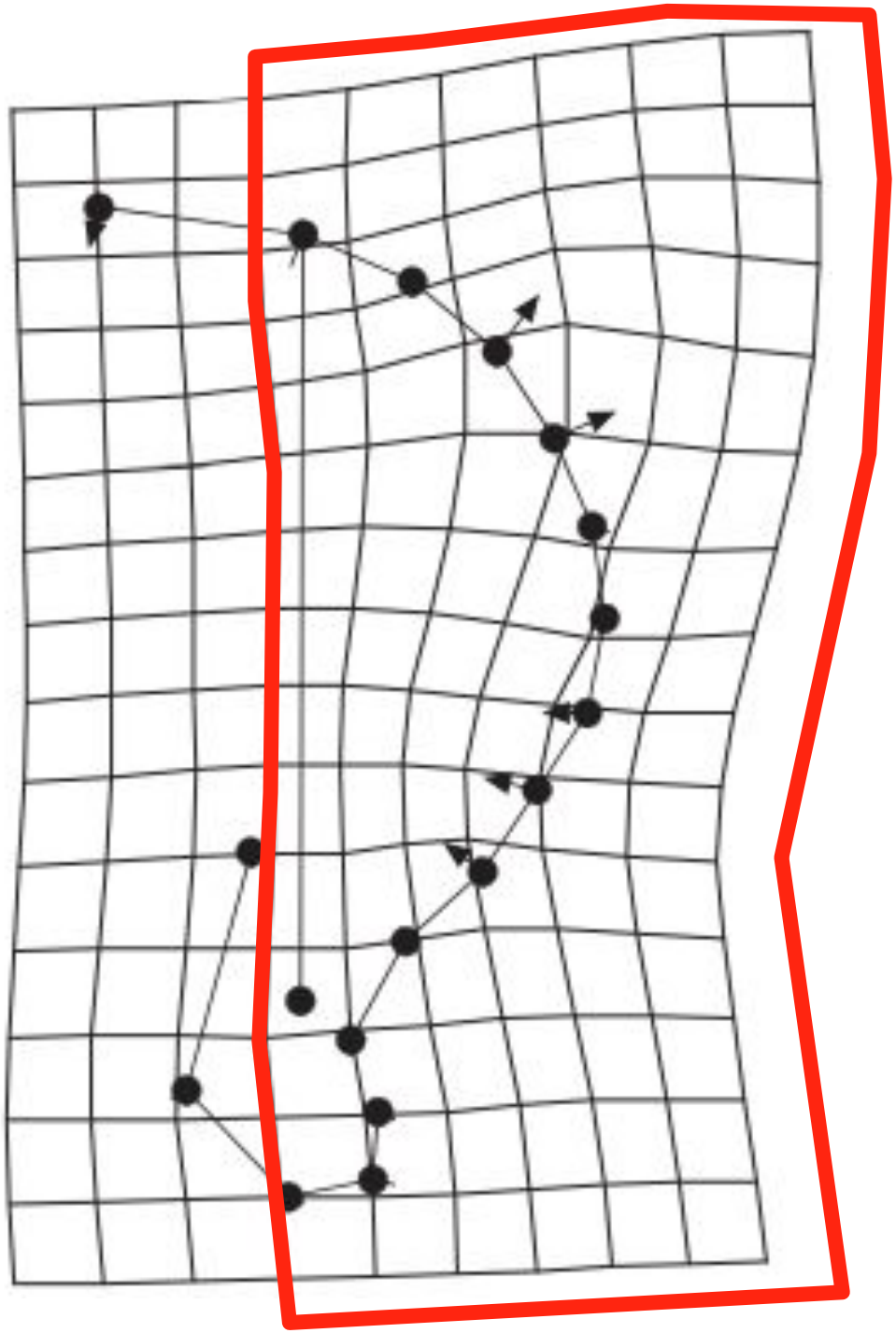


Se tratarmos da mesma maneira

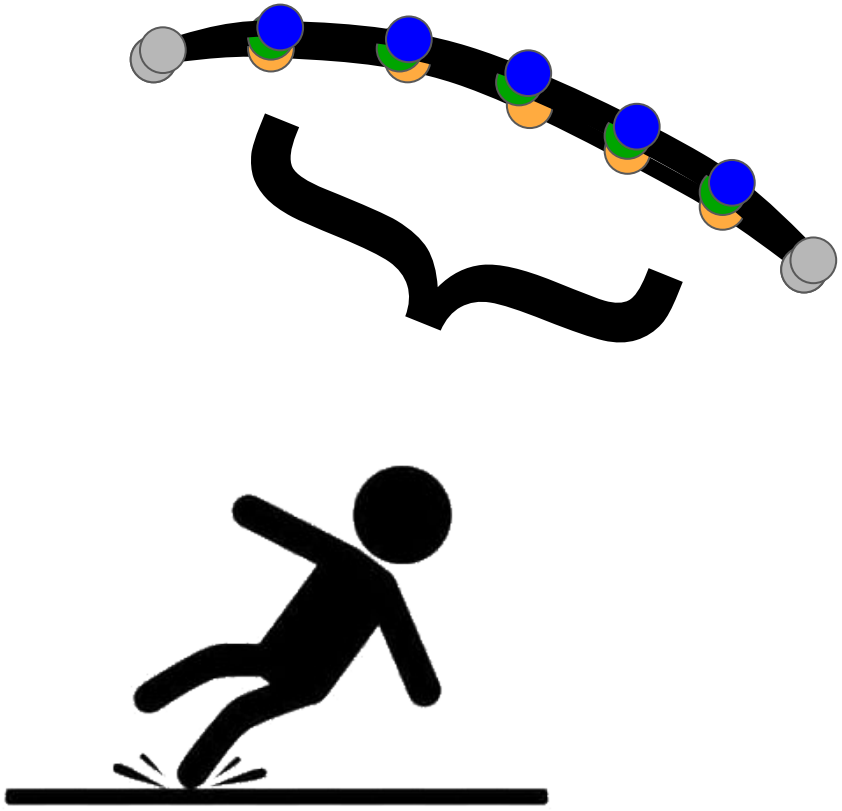
Se tratarmos da mesma maneira



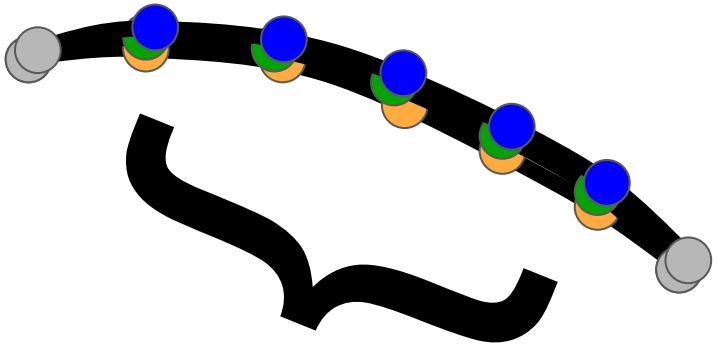
Se tratarmos da mesma maneira

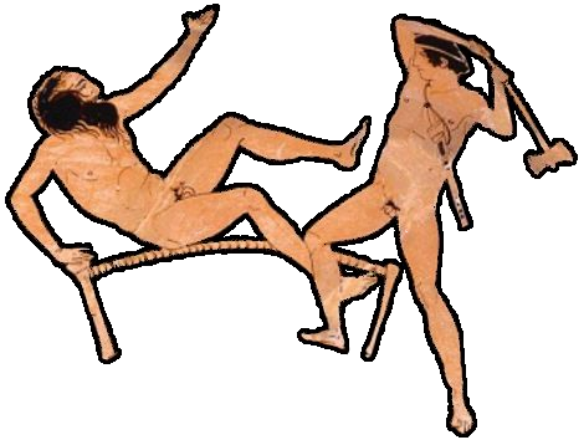


Sliding (deslizamento)



Sliding (deslizamento)



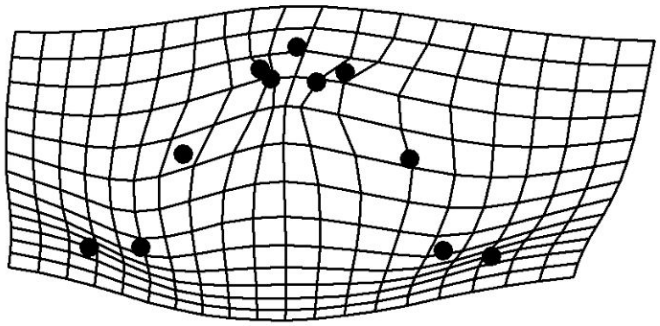


Consiste na aplicação de uma GPA local

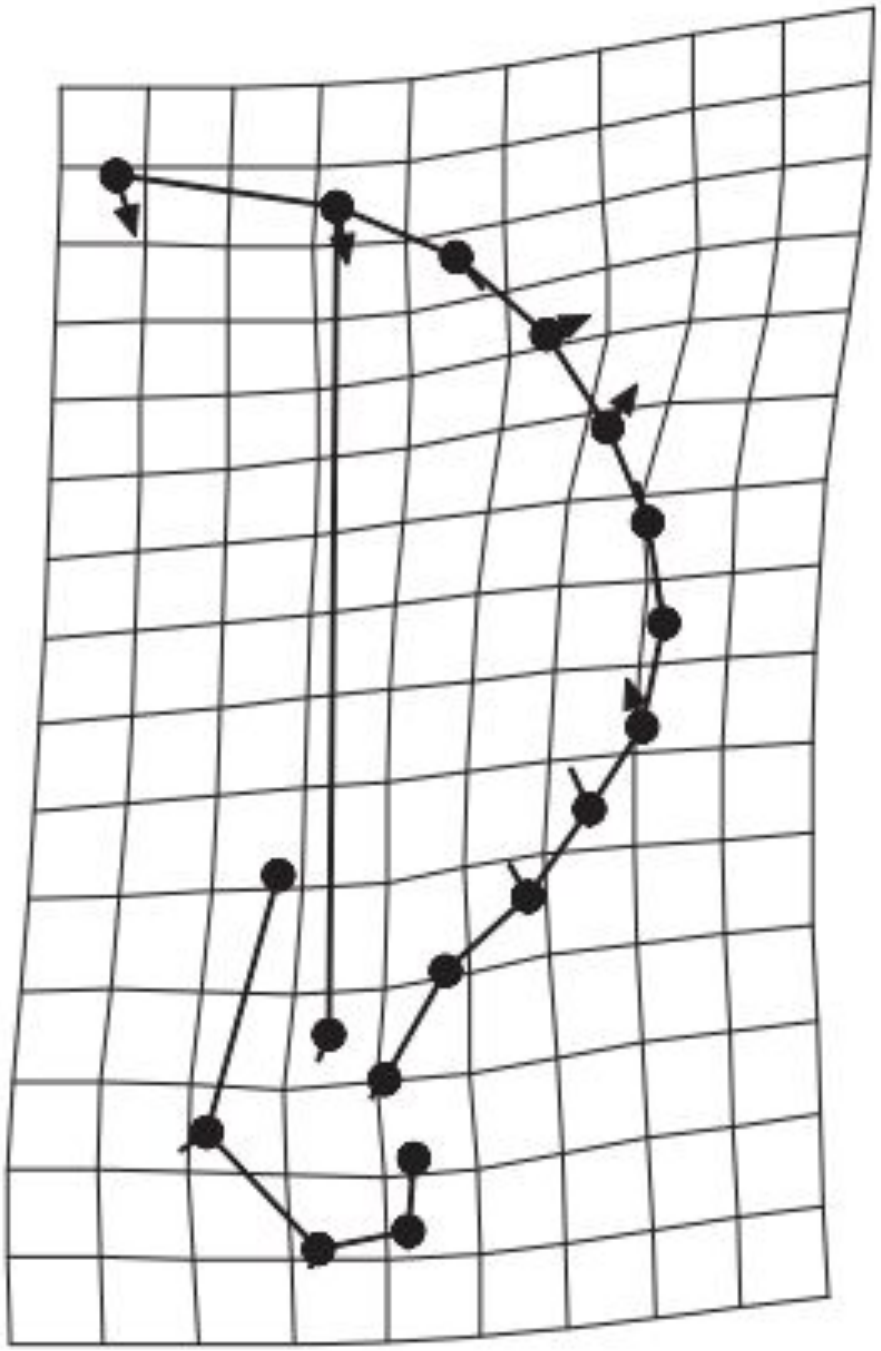
Sliding (deslizamento)

- ***Minimização da energia de bending***

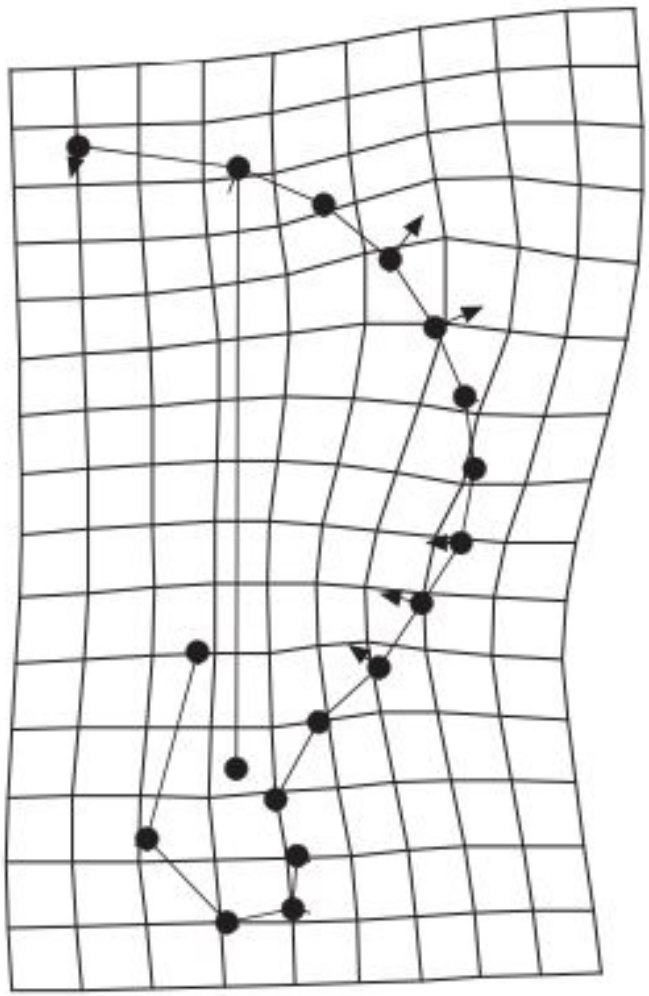
  Conformação que menos distorce a grade tps após uma análise de Procrustes aplicada aos semilandmarks



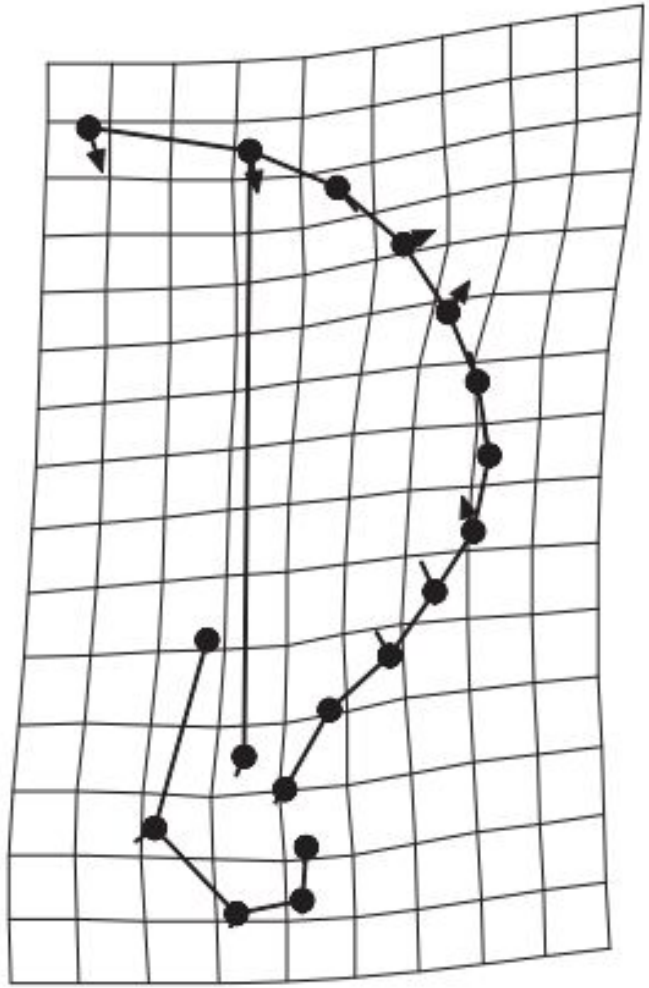
Minimizando a energia de bending (MEB)



Comparando



s/ correção

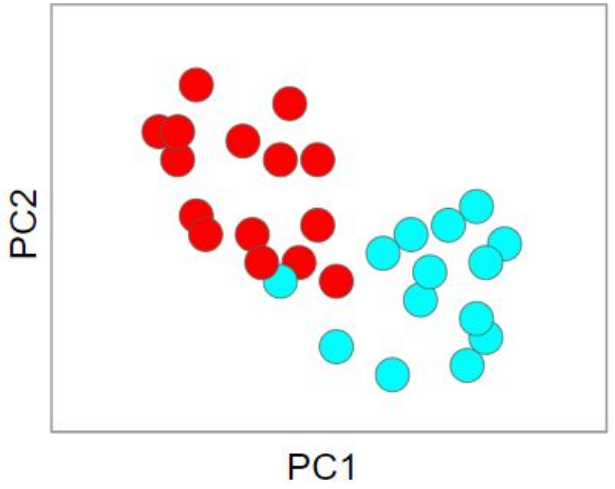


correção por MEB

Sliding (deslizamento)

- ***Minimização de Distância Procrustes***

  Semilandmarks são ajustados para minimizar a distância Procrustes do que seria um "morfoespaço" gerado para as curvas



E se desse pra analisar a forma sem usar landmarks?

Transformada de Fourier Elíptica

COMPUTER GRAPHICS AND IMAGE PROCESSING **18**, 236–258 (1982)

Elliptic Fourier Features of a Closed Contour[1]

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U.S. Army Armament Research and Development Command, Dover, New Jersey 07801

AND

CHARLES R. GIARDINA

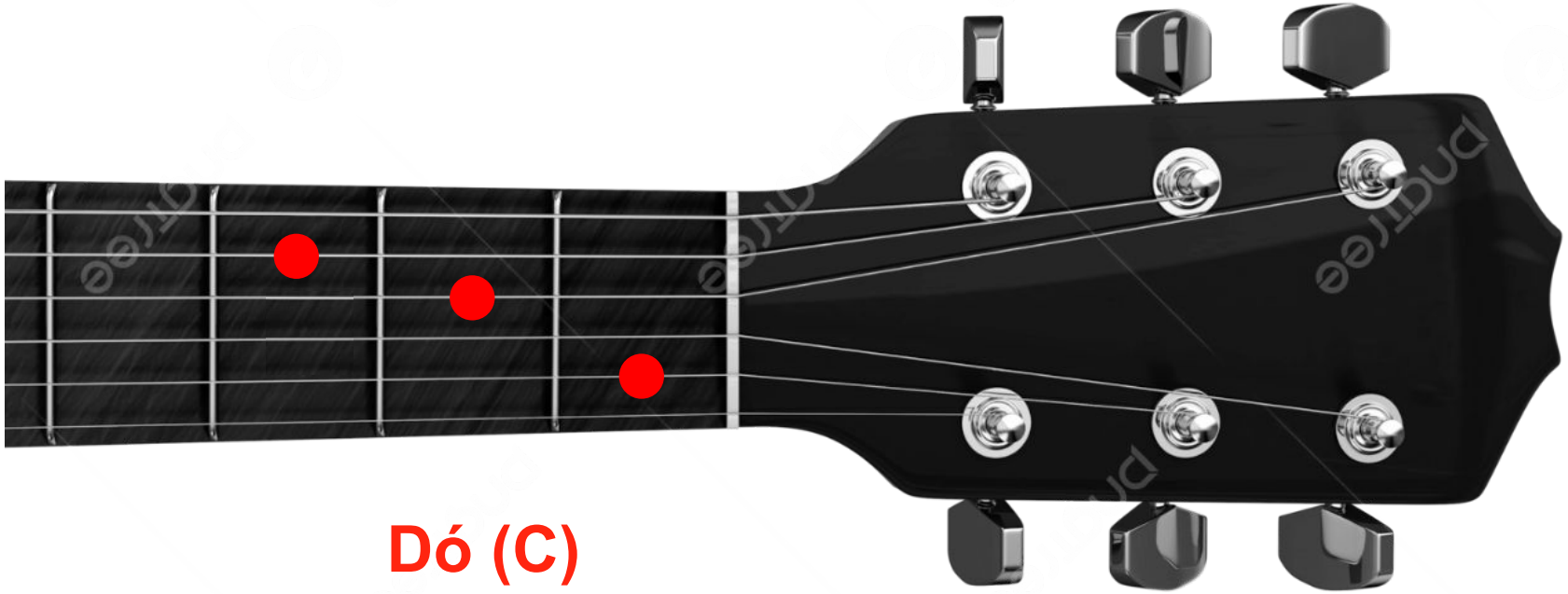
Fairleigh Dickinson University, Teaneck, New Jersey 07070

Received June 22, 1981

Transformada de Fourier Elíptica

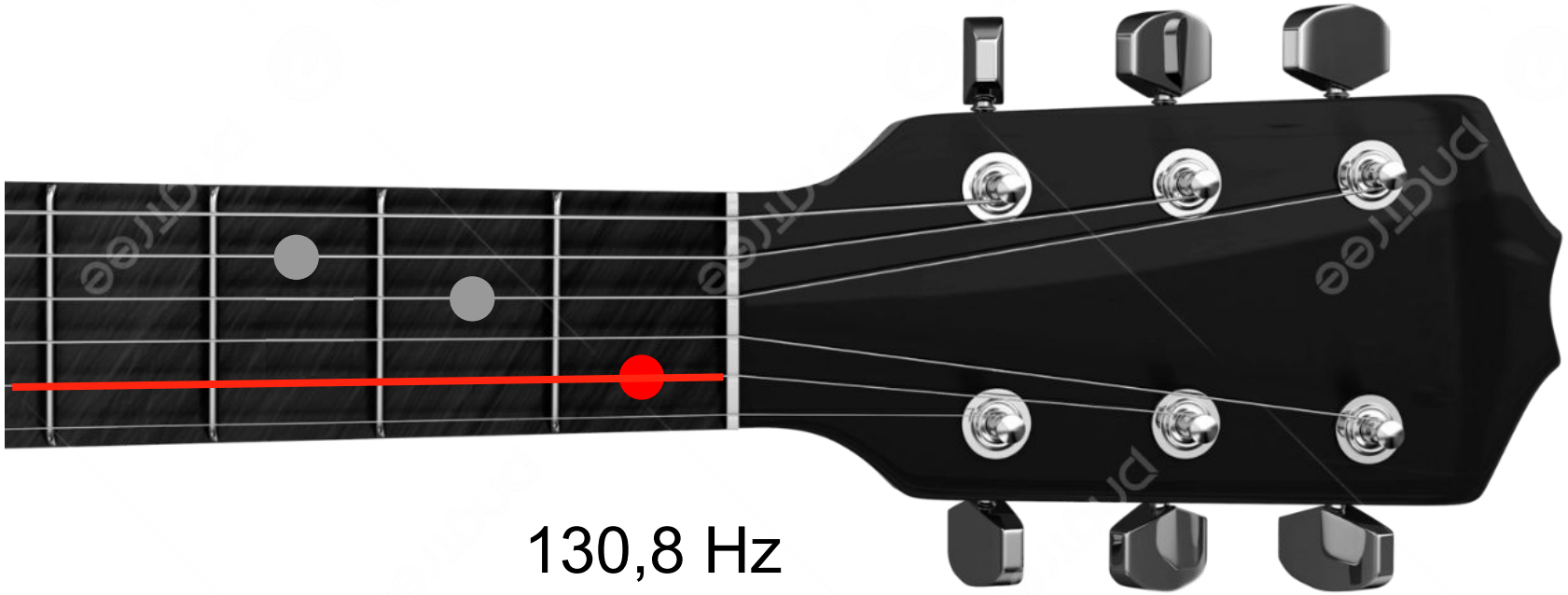
- *É a decomposição de contornos de um objeto em harmônicos elípticos*

Confiem em mim kkkk

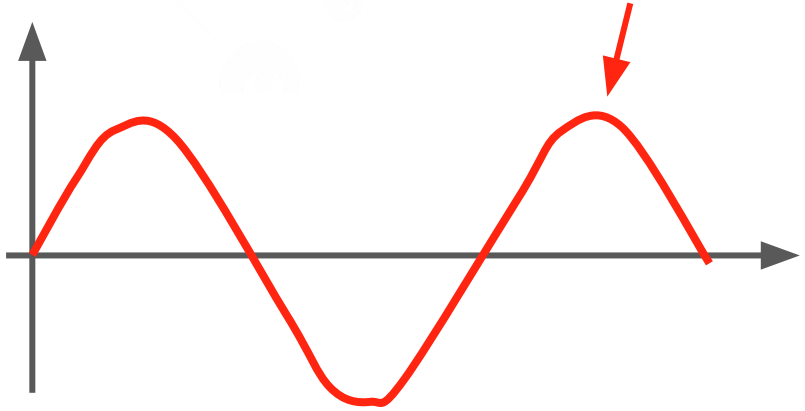


Dó (C)

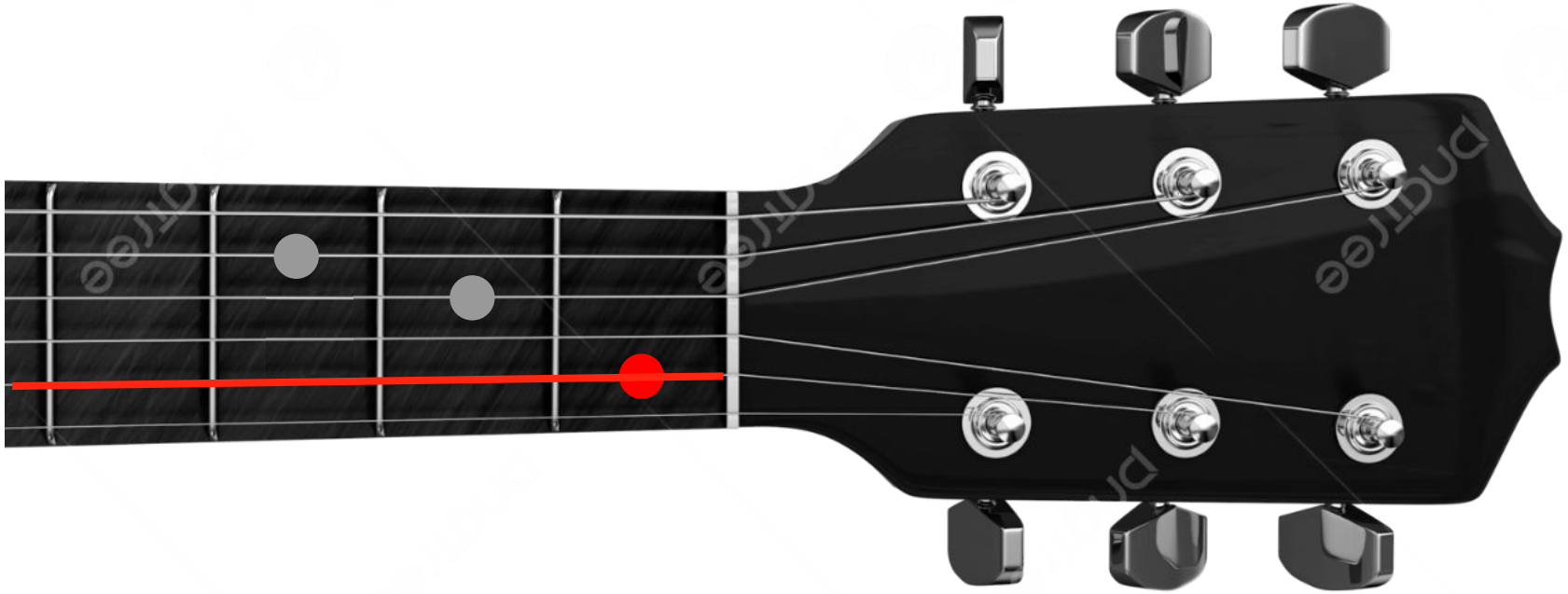
Confiem em mim kkkk

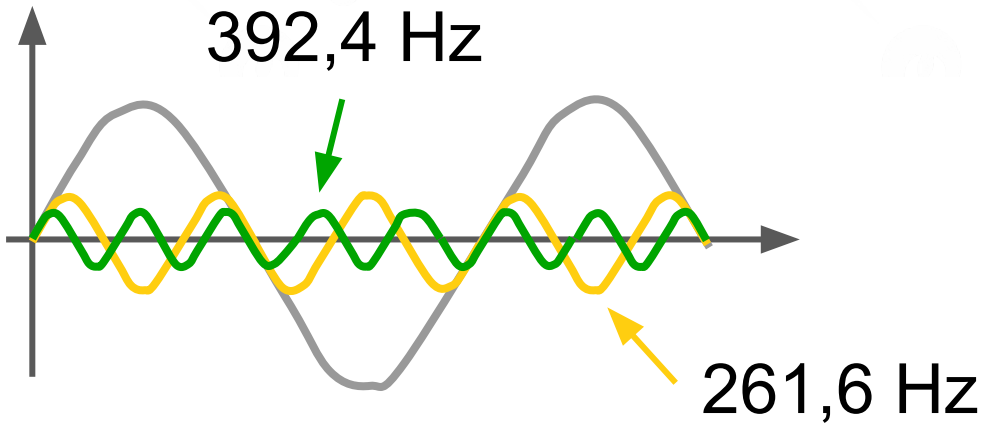


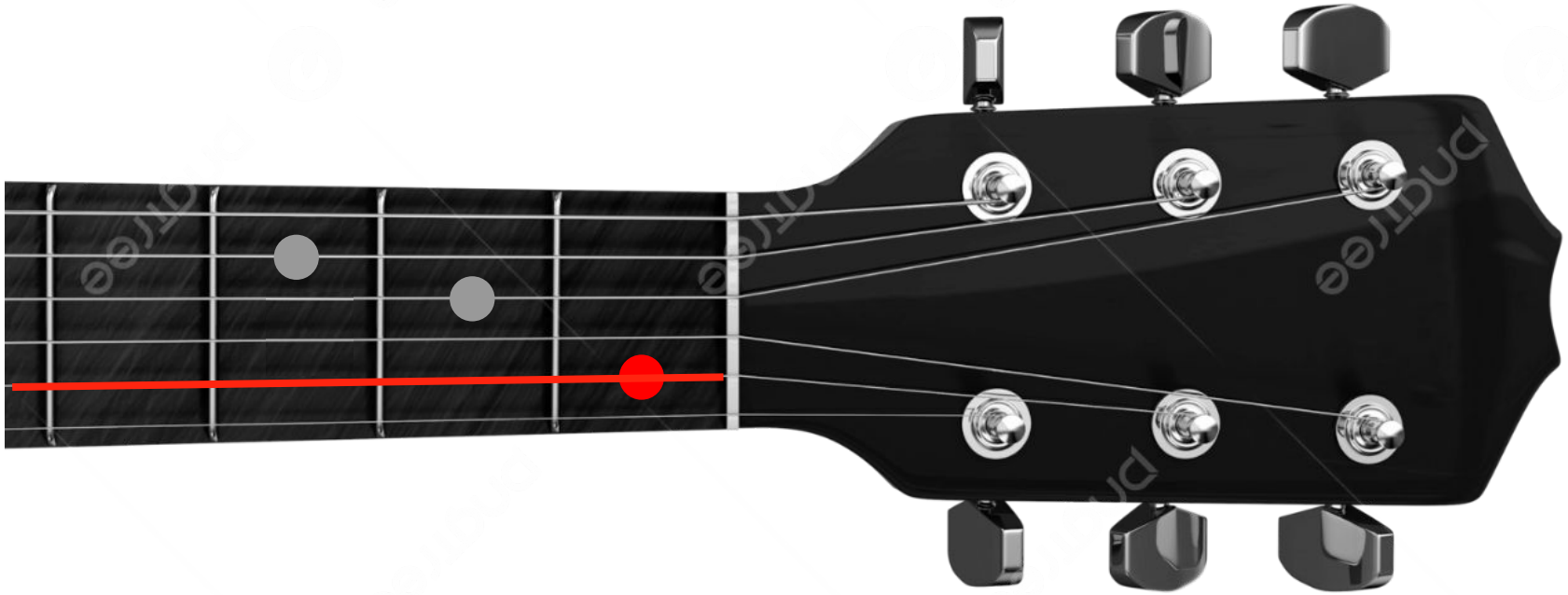
130,8 Hz

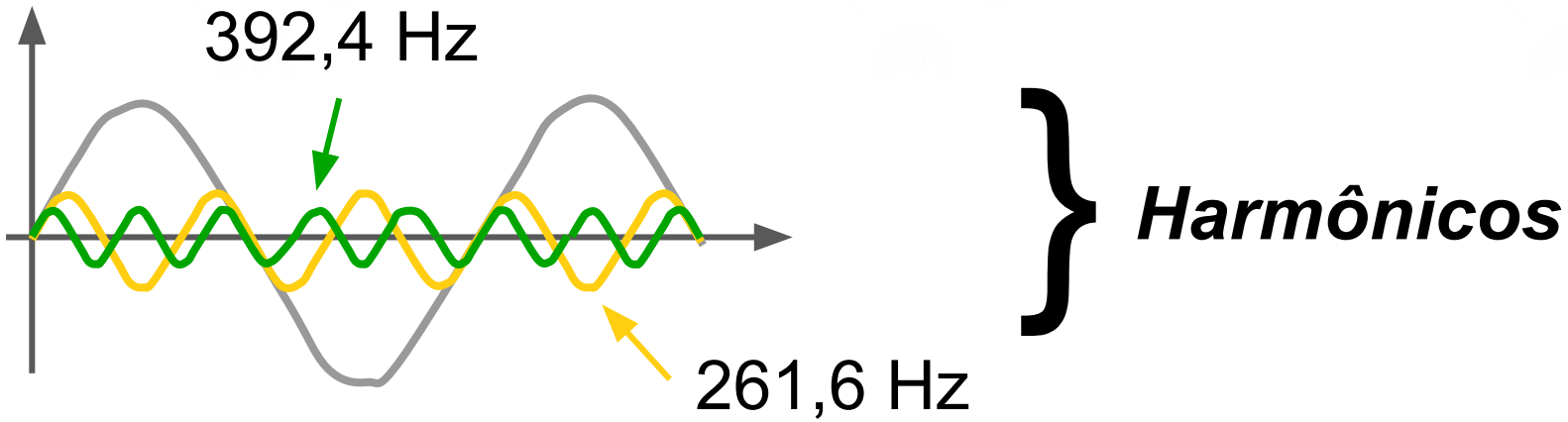


Confiem em mim kkkk



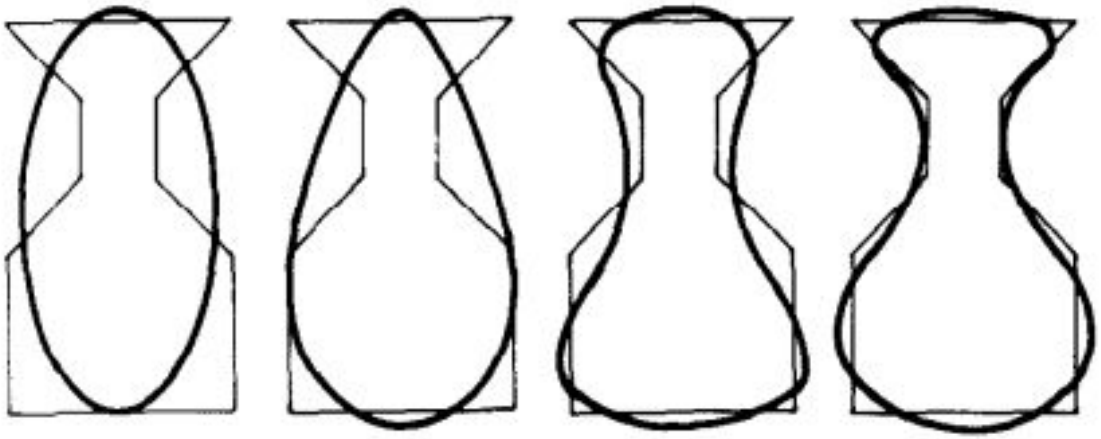





392,4 Hz
261,6 Hz
Harmônicos

Transformada de Fourier Elíptica

- *É a decomposição de contornos de um objeto em harmônicos elípticos*
- *Aplicável a:*
  - *Formas fechadas*
  - *2D*



Transf. Elíptica de Fourier

$$x(t) = a_0 + \sum_{n=1}^{N} [a_n \cos(nt) + b_n \sin(nt)]$$

$$y(t) = c_0 + \sum_{n=1}^{N} [c_n \cos(nt) + d_n \sin(nt)]$$

Transf. Elíptica de Fourier

$$x(t) = a_0 + \sum_{n=1}^{N} [a_n \cos(nt) + b_n \sin(nt)]$$

$$y(t) = c_0 + \sum_{n=1}^{N} [c_n \cos(nt) + d_n \sin(nt)]$$

Valores de x e y *ao longo da curva*

Transf. Elíptica de Fourier

$$x(t) = a_0 + \sum_{n=1}^{N} [a_n \cos(nt) + b_n \sin(nt)]$$

$$y(t) = c_0 + \sum_{n=1}^{N} [c_n \cos(nt) + d_n \sin(nt)]$$

Número de harmônicos

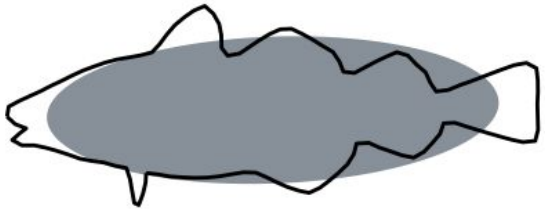
Transf. Elíptica de Fourier

$$x(t) = a_0 + \sum_{n=1}^{N} [a_n \cos(nt) + b_n \sin(nt)]$$

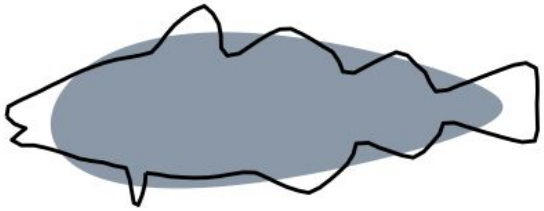
$$y(t) = c_0 + \sum_{n=1}^{N} [c_n \cos(nt) + d_n \sin(nt)]$$

Coeficientes dos harmônicos

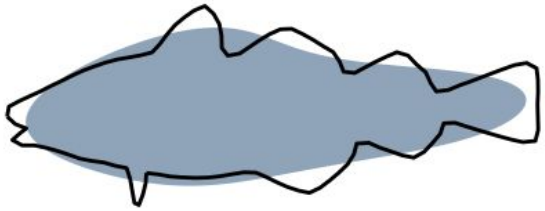
1



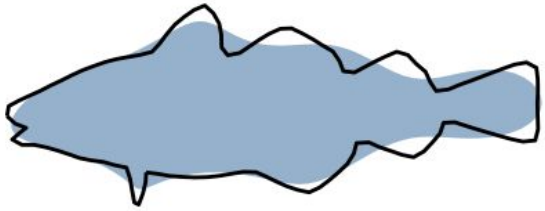
2



3



4



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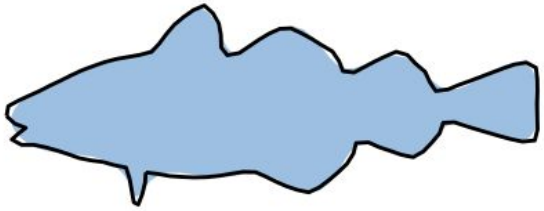

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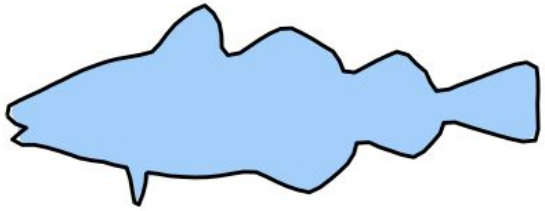
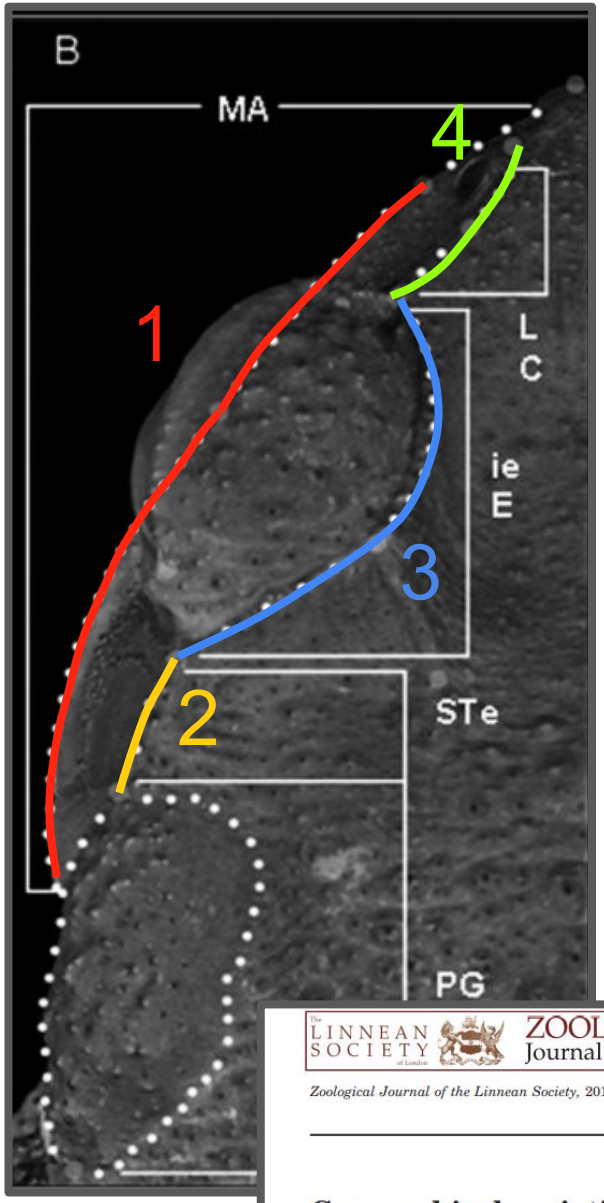


Exemplo

Agora, vamos pro

Landmarks que usaremos



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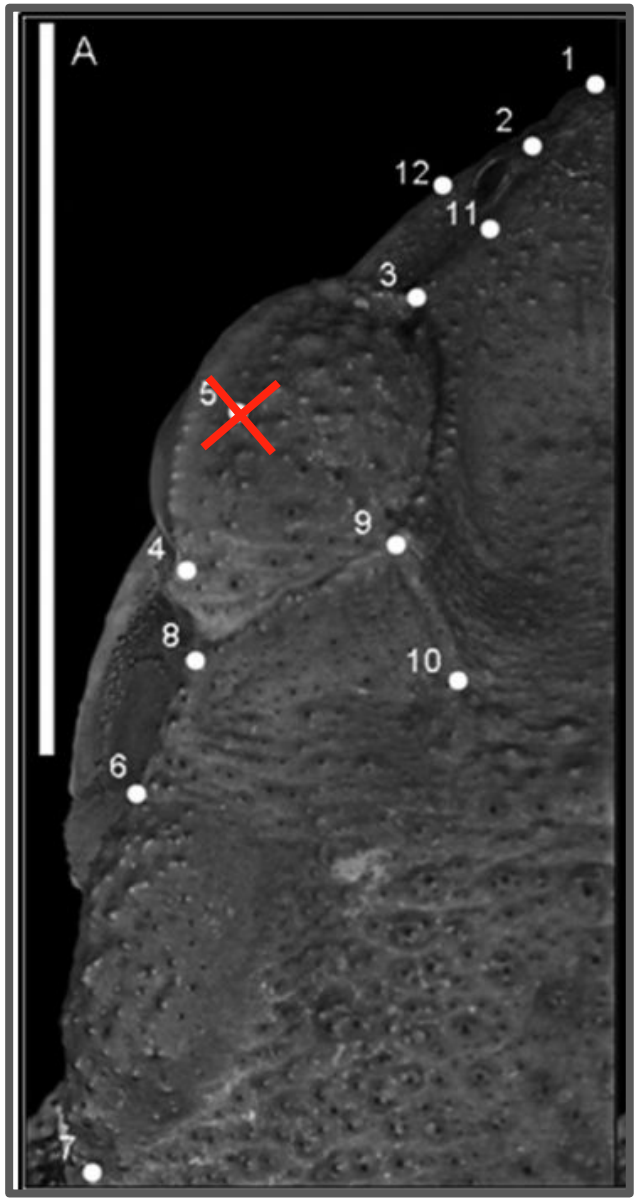

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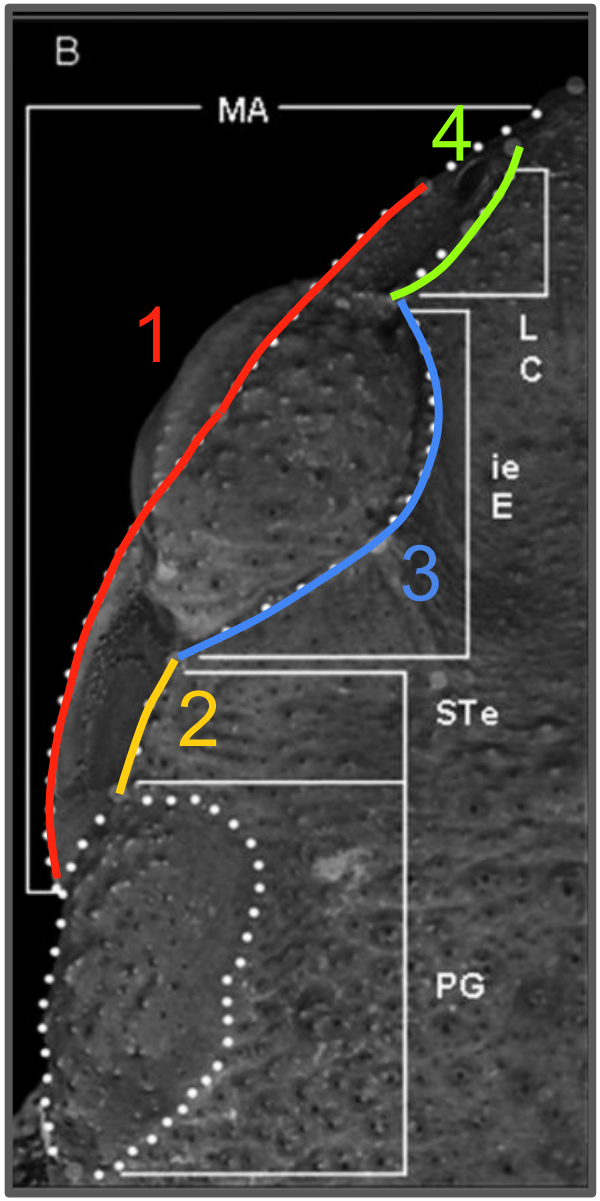

Semilandmarks que usaremos

- Curva 1:
  - MA, n=30
- Curva 2:
  - STe, n=10
- Curva 3:
  - ieE, n=30
- Curva 4:
  - LC, n=20

} Todos posicionados de baixo pra cima

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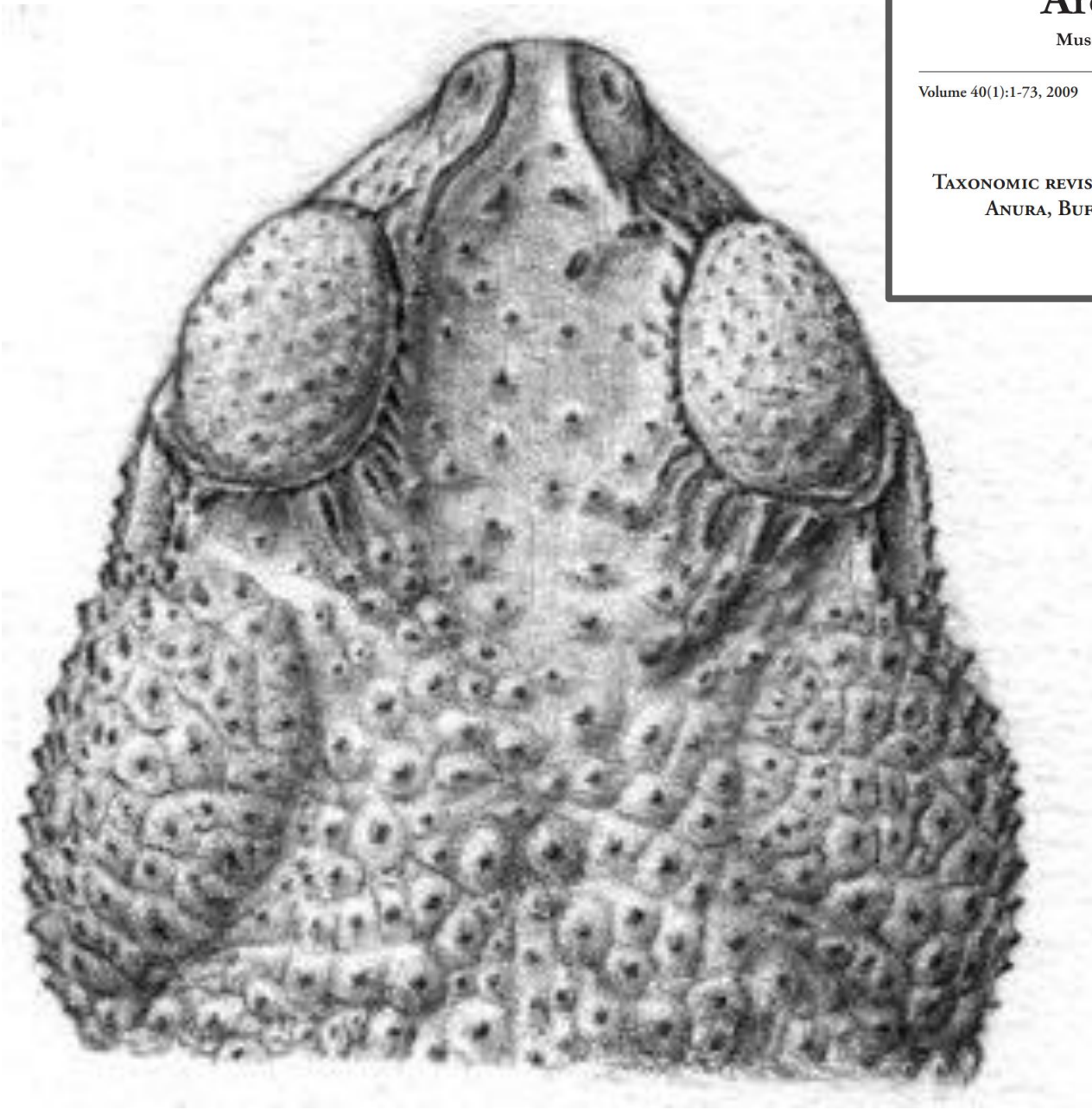

Arquivos de Zoologia

Museu de Zoologia da Universidade de São Paulo

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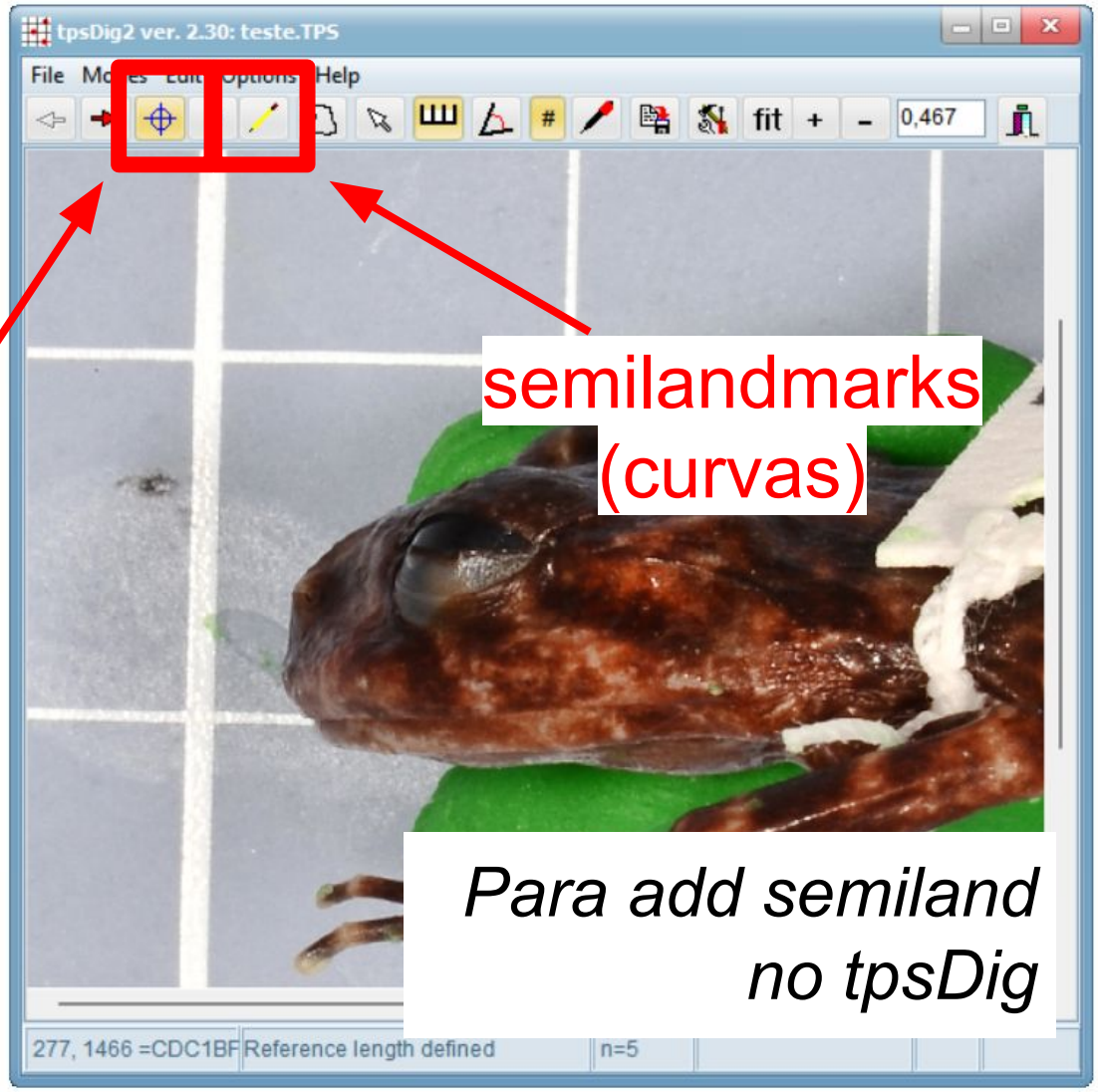
Patrícia Narvaes[1,2]
Miguel Trefaut Rodrigues[1,3]

tpsUtil

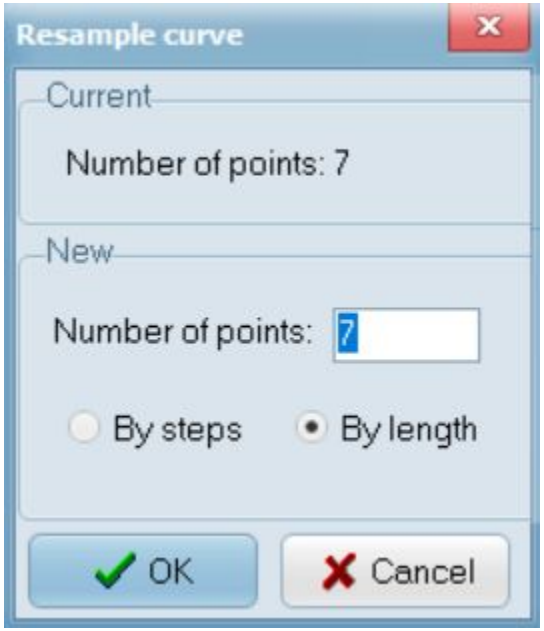
landmarks
(pontos)



tpsDig

Por fim:

- *clique com botão direito sobre a curva > Resample curve > indique o nº de landmarks*



tpsDig