COORDINATE GRID TRANSFORMATIONS

Dürer 1613

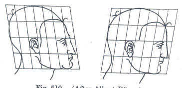


Fig. 510. (After Albert Dürer.)

Thompson 1917

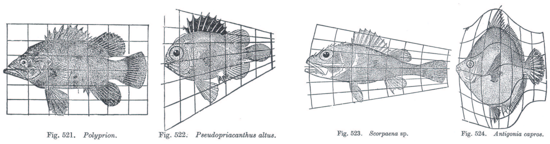
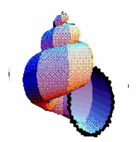
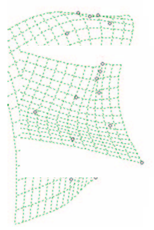
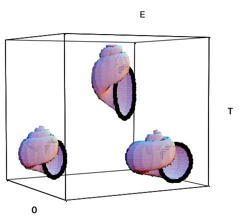


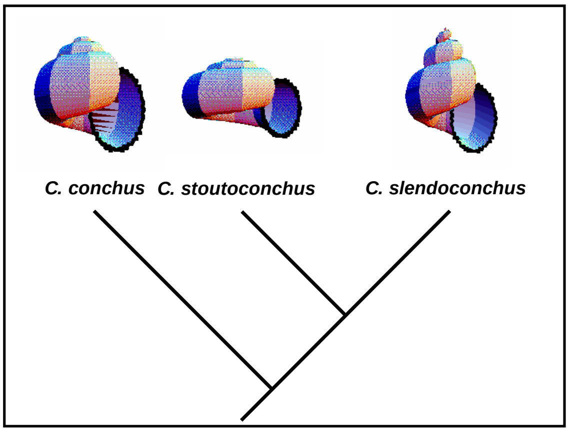
Fig. 521. *Polyprion.* Fig. 522. *Pseudopriacanthus altus.* Fig. 523. *Scorpaena* sp. Fig. 524. *Antigonia capros.*

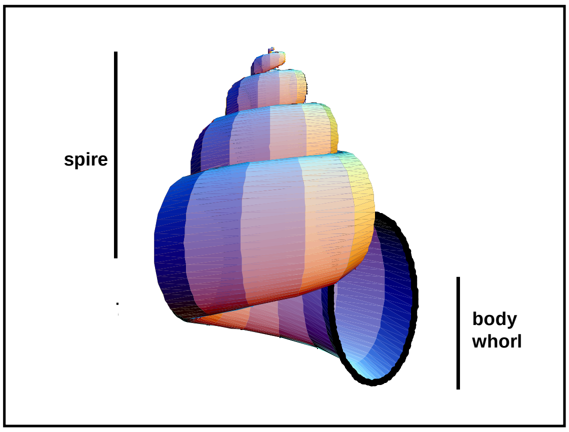
GEOMETRIC MORHOMETRICS

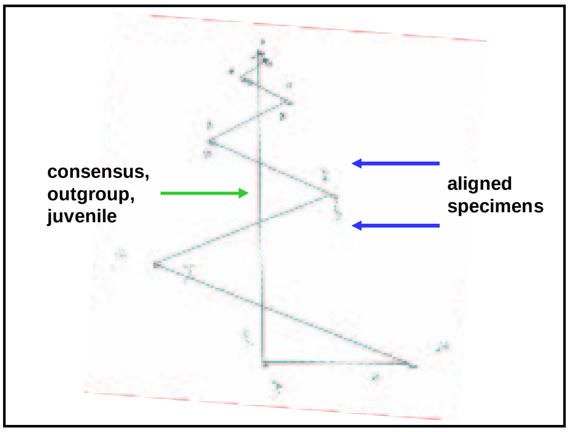







C. conchus
C. stoutoconchus
C. slendoconchus


spire
body
whorl


consensus,
outgroup,
juvenile
aligned
specimens

PARTITIONED MATRIX L

$$L = \begin{pmatrix} P & Q \\ Q^t & 0 \end{pmatrix}$$

BENDING ENERGY MATRIX L_p^{-1}

$L_p^{-1} = E \, \Lambda \, E^t$

E are ‘principal warps’

Λ is p x p matrix containing eigenvalues

WEIGHT MATRIX W

$W = [Wx \mid Wy]$

$W = V(I_2 \otimes E \, \Lambda^{-\alpha / 2}) / n^{1/2}$

$V = [V_x \mid V_y]$

$V_x = X_x - 1_n \otimes [0 \mid 1] \, X_c$

$V_x = X_y - 1_n \otimes [0 \mid 1] \, X_c$

NORMALISED MATRIX N

$$N = W n^{1/2} (I_2 \otimes \Lambda^{(1+\alpha/2)} E^t)$$

$$N = V(I_2 \otimes L_p^{-1})$$

RELATIVE WARP MATRIX R

$$W = S D R^t$$

THIN-PLATE SPLINE RELATIVE WARP ANALYSIS

Principal Warps are eigenfunctions for bending energy matrix

Partial Warps are obtained by projecting specimens onto principal warps

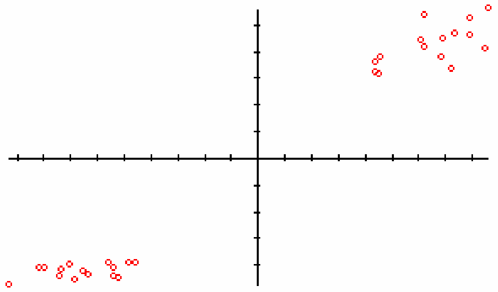
Relative Warps are principal component axes for space in which each point correspondsto a specimen and axes are inversely weighted principal warps

PRINCIPAL WARPS

p x p matrix containing eigenvectors with associated eigenvalues that scale inversely with magnitude

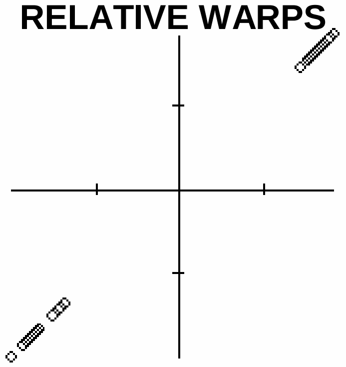
p x p - 3 if affine components are ignored

PARTIAL WARPS

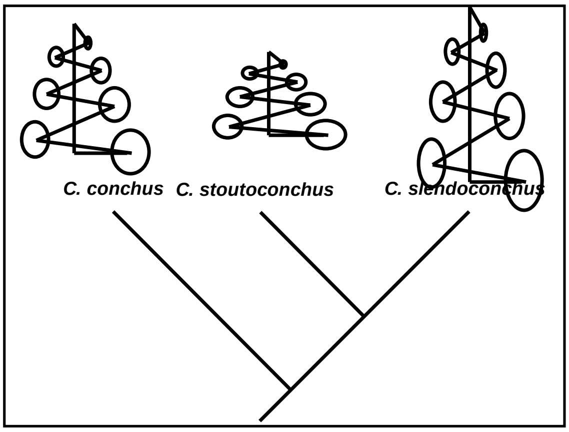


partial warp 1

RELATIVE WARPS



relative warp (1, 1)


C. conchus
C. stoutoconchus
C. slendoconchus