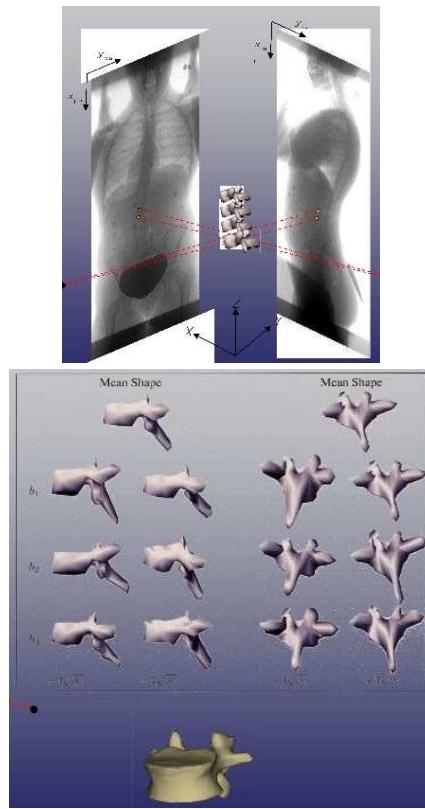


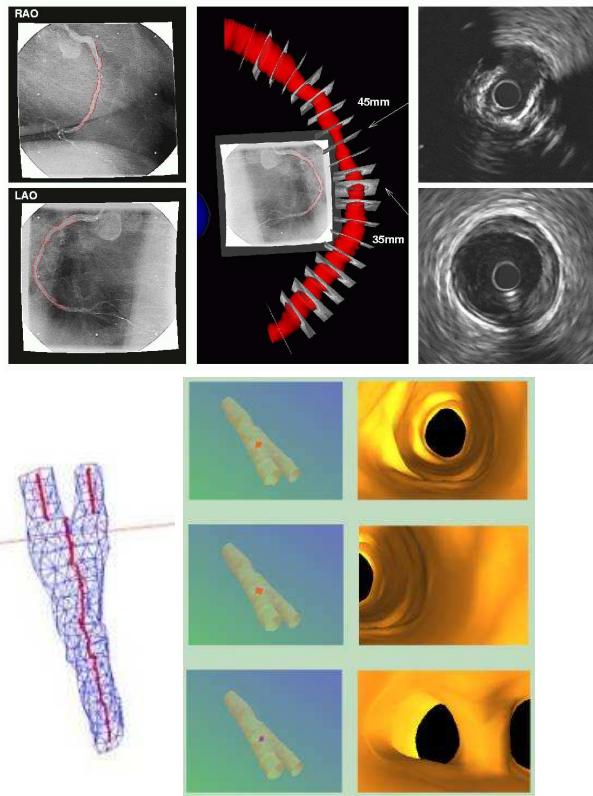
INTRODUCTION

Reconstruction 3D de la Colonne Vertébrale



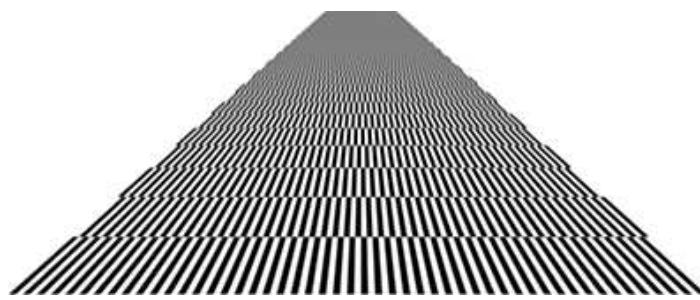
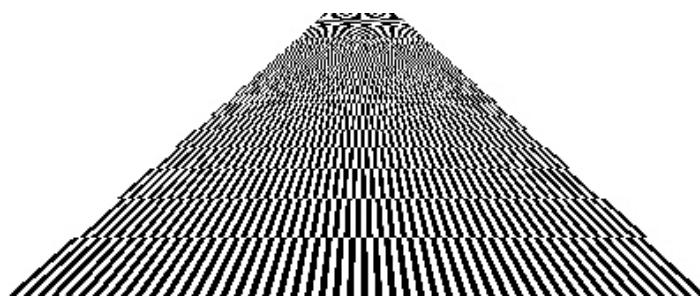
INTRODUCTION

Reconstruction Angiographique



TRANSFORMÉ DE FOURIER

Aliasing & Antialiasing



TFD
Périodisation Implicite de l'Image

$$\text{TFD} \left(\begin{array}{c} \text{Portrait of a man} \end{array} \right)$$

=

$$\text{TF} \left(\begin{array}{c} \dots \\ \begin{array}{cccc} \text{Portrait of a man} & \text{Portrait of a man} & \text{Portrait of a man} & \text{Portrait of a man} \\ \vdots & \vdots & \vdots & \vdots \\ \text{Portrait of a man} & \text{Portrait of a man} & \text{Portrait of a man} & \text{Portrait of a man} \\ \vdots & \vdots & \vdots & \vdots \\ \text{Portrait of a man} & \text{Portrait of a man} & \text{Portrait of a man} & \text{Portrait of a man} \end{array} \\ \dots \end{array} \right)$$

TP1
Algorithmiquement

$$f(x, y) \xrightarrow{\mathcal{F}} F(u, \nu) = R(u, \nu) + jI(u, \nu)$$

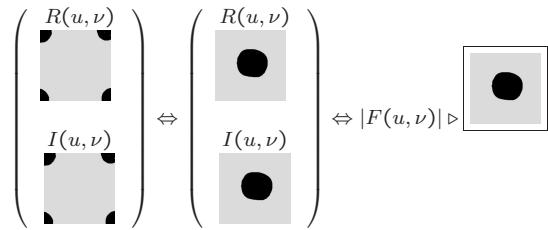
$$\mathbf{TFD} \begin{pmatrix} \text{Réel} \\ \text{Imaginaire} \\ \text{ZÉROS INSIDE} \end{pmatrix} = \begin{pmatrix} R(u, \nu) \\ I(u, \nu) \end{pmatrix}$$

et

$$\mathbf{TFD}^{-1} \begin{pmatrix} R(u, \nu) \text{ avec centre informatique} \\ I(u, \nu) \text{ avec centre informatique} \end{pmatrix} = \begin{pmatrix} \text{Image traitée} \\ \text{Abstraction} \end{pmatrix}$$

TP1
Modification et Visualisation du Module

$$|F(u, \nu)| = \sqrt{R^2(u, \nu) + I^2(u, \nu)}$$



Exemples

$$|F(u = 3, \nu = 3)| = 0 \quad \Leftrightarrow \quad \begin{matrix} R(u = 3, \nu = 3) = 0 \\ I(u = 3, \nu = 3) = 0 \end{matrix}$$

$$|F(u = 3, \nu = 3)| \times 2 \quad \Leftrightarrow \quad \begin{matrix} R(u = 3, \nu = 3) \times 2 \\ I(u = 3, \nu = 3) \times 2 \end{matrix}$$

Nota -1-

Mult et $(1 + \log)$

► seulement pour la visualisation d'un module de spectre !

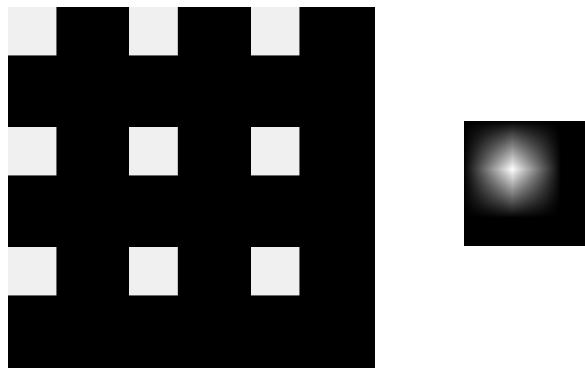
Nota -2-

discontinuités horizontales $\xrightarrow{\mathcal{F}}$ discontinuités verticales

TP1
Recouvrement Spatial



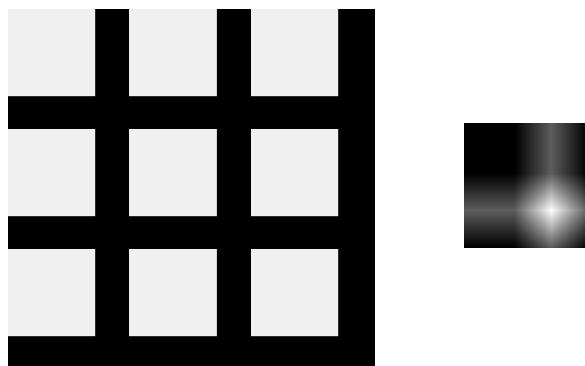
En utilisant la TFD



TP1
Recouvrement Spatial

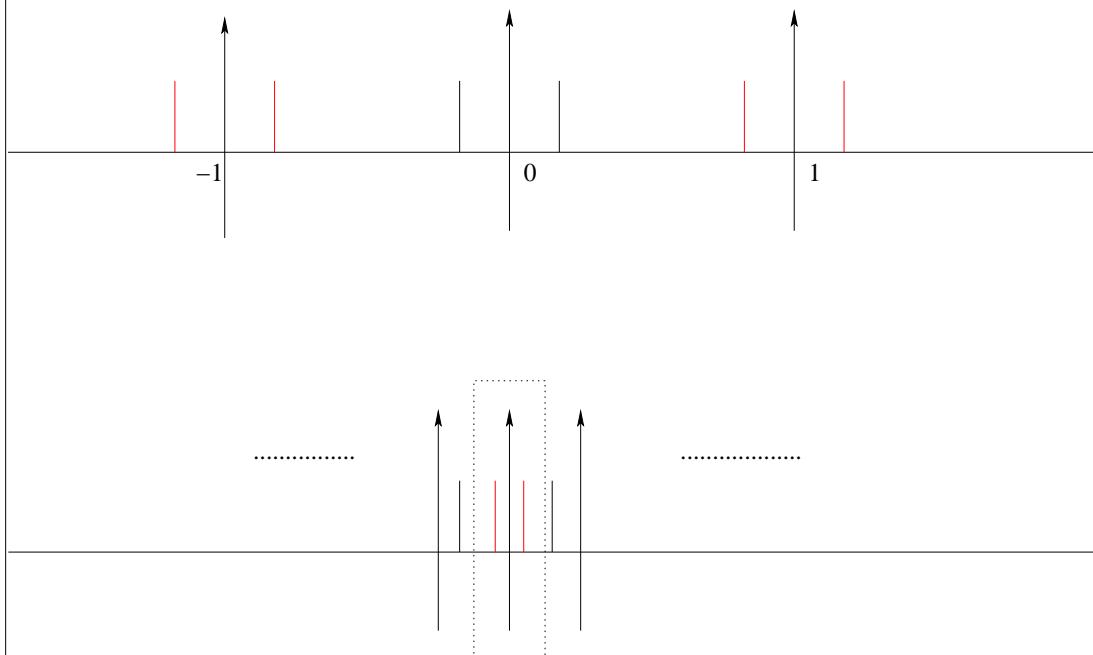


En utilisant la TFD

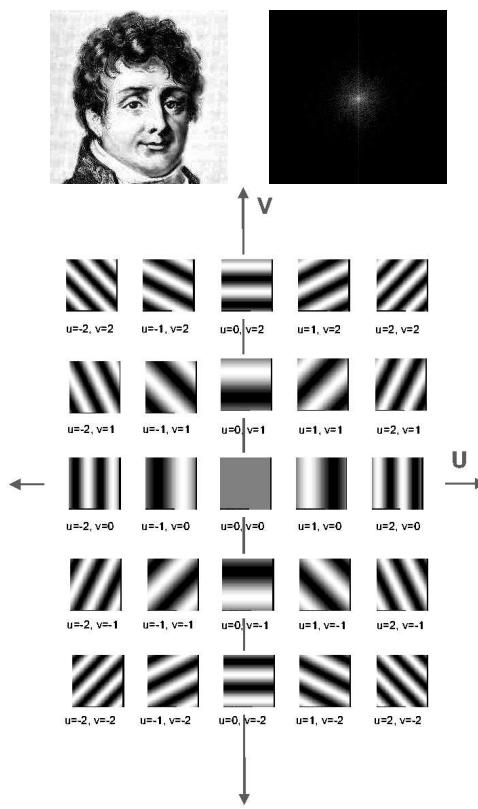


TP1
Sous-Échantillonage

X



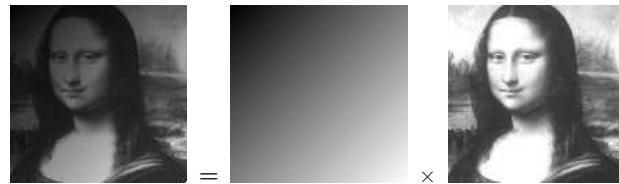
TF DISCRÈTE
TF discrète 2D (Interprétation)



FILTRE FRÉQUENTIEL

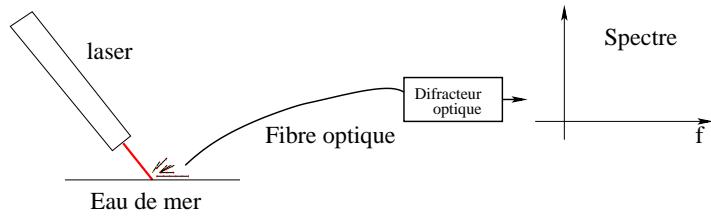
Filtrage Homomorphique

$$f(x, y) = i(x, y) \cdot r(x, y)$$

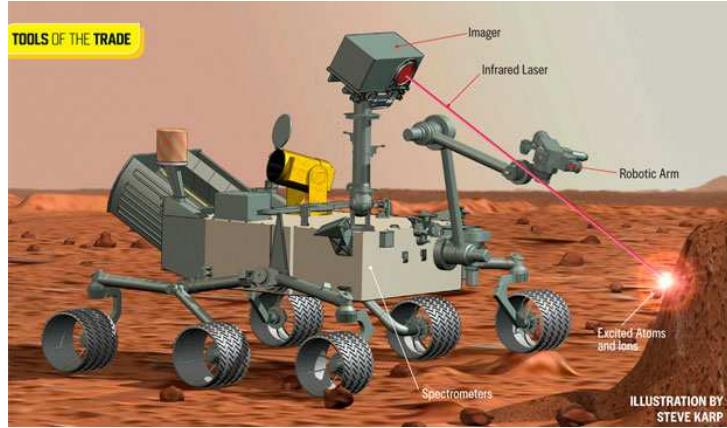


RESTAURATION
Déconvolution de Fonction d'Appareil

LOE (Ifremer)



RESTAURATION
Mars Curiosity



RESTAURATION
Estimation de la PSF



14

RESTAURATION
Estimation de la PSF



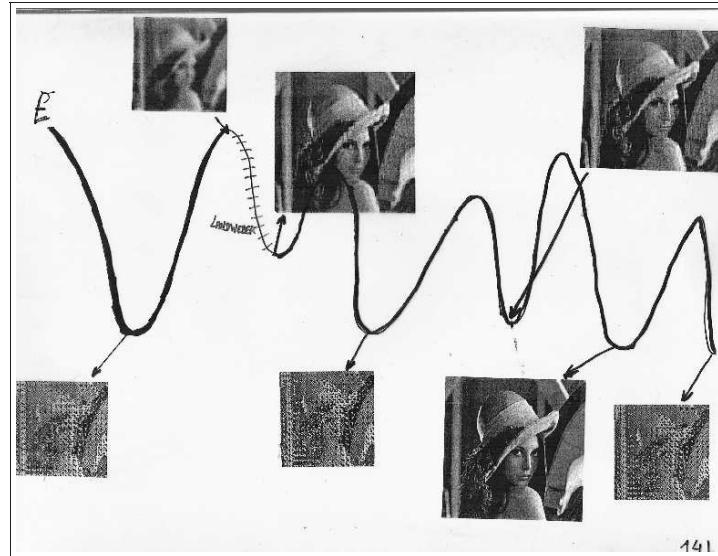
RESTAURATION

Méthodes Itératives

Méthodes Itératives & Problèmes Inverse Mal-Posés

Fonction de coût :

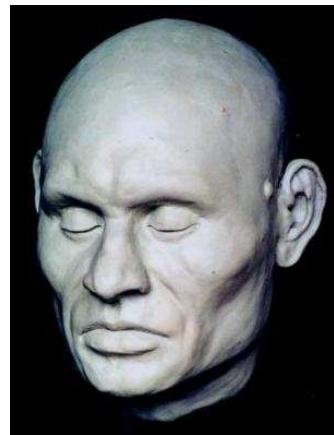
$$\hat{f}(x, y) = \arg \min_{\hat{f}} \left\{ \| \hat{f}(x, y) - f(x, y) \|^2 \right\}$$
$$\hat{f}(x, y) = \arg \min_f \left\{ \| g(x, y) - h(x, y) * \hat{f}(x, y) \|^2 \right\}$$



TOMOGRAPHIE

Applications (1)

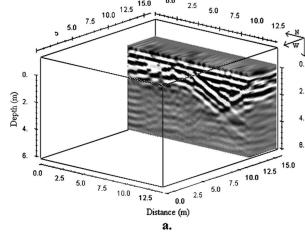
Reconstruction faciale de l'intérieur d'une momie



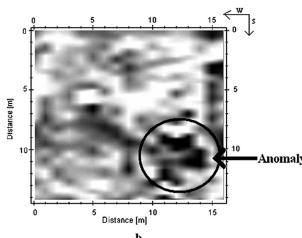
TOMOGRAPHIE

Applications (2)

Detection de chambre mortuaires



a.



b.

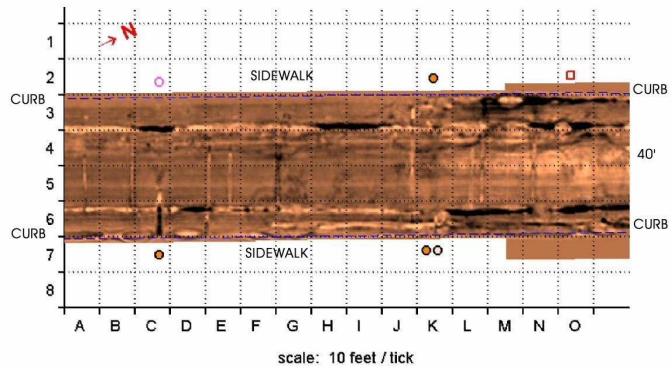
TOMOGRAPHIE

Applications (3)

Tomographie Radar des sols

WITTEN TECHNOLOGIES, INC
RADAR TOMOGRAPHY IMAGE OF UTILITIES AT 23" OF DEPTH
160' X 40'

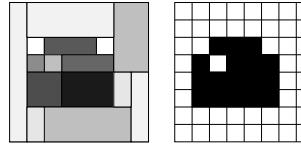
Jax - Courthouse Slice 23 Depth = 23 inches



SEGMENTATION D'IMAGES

ICM : Exemple de Calcul

$$\hat{x}_{MAP} = \arg \min_x \left\{ \underbrace{\sum_{s \in S} \left[\ln(\sqrt{2\pi}\sigma_{x_s}) + \frac{(y_s - \mu_{x_s})^2}{2\sigma_{x_s}^2} \right]}_{V(x,y)} + \underbrace{\sum_{c \in C} \beta_c [1 - \delta(x_s, x_t)]}_{U(x)} \right\}$$



Voisinage du 2nd ordre avec cliques binaires
 $U(x) = \sum_{c \in C} V_c(x)$ avec $V_c(x) = [1 - \delta(x_s, x_t)]$

- **A PRIORI**

$$P_{X_s}(xs = \blacksquare) = \frac{1}{Z} \exp \left\{ - \sum_{c \in C} V_c(xs = \blacksquare) \right\} =$$

$$P_{X_s}(xs = \square) = \frac{1}{Z} \exp \left\{ - \sum_{c \in C} V_c(xs = \square) \right\} =$$

- **VRAISSEMBLANCE**

$$p_{Y_s/X_s}(y_s/xs = \square) = \mathcal{N}(200, 10) \quad \& \quad p_{Y_s/X_s}(y_s/xs = \blacksquare) = \mathcal{N}(100, 10)$$

- $y_s = 160 \triangleright$

- $y_s = 155 \triangleright$

SEGMENTATION D'IMAGES

RS : Effet de la Température

$$P_{X_s/X_{\nu_s}, Y_s}(x_s/\eta_s, y_s) = \frac{1}{Z_s} \exp \left\{ -\frac{1}{T_k} (U(.)) \right\}$$

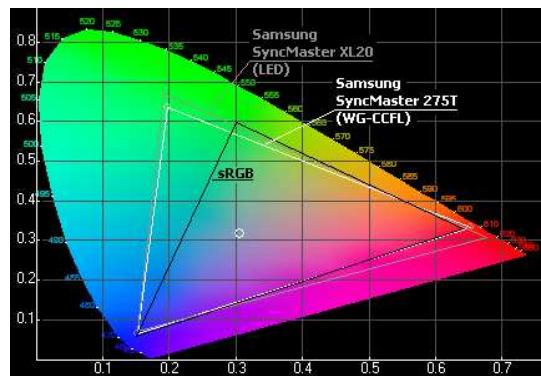
$$U_{\blacksquare} = 0.85 \quad U_{\square} = 0.15$$

$\boxed{\mathbf{T=1} \triangleright}$ $P(\blacksquare/y_s) = \frac{e^{-0.85}}{e^{-0.85} + e^{-0.15}} =$	$P(\square/y_s) = \frac{e^{-0.15}}{\mathcal{D}} =$
---	--

$\boxed{\mathbf{T=10} \triangleright}$ $P(\blacksquare/y_s) = \frac{e^{-0.85/10}}{e^{-0.85/10} + e^{-0.15/10}} =$	$P(\square/y_s) = \frac{e^{-0.15/10}}{\mathcal{D}} =$
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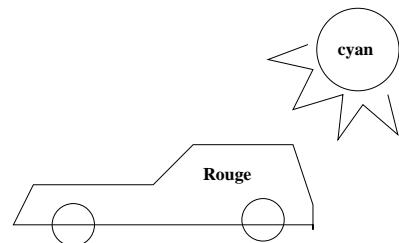
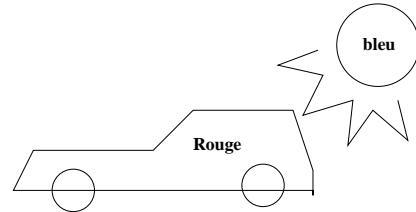
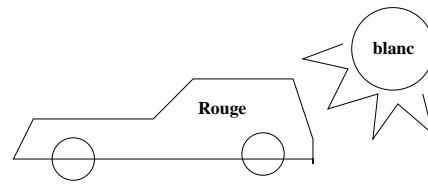
$\boxed{\mathbf{T=0.1} \triangleright}$ $P(\blacksquare/y_s) = \frac{e^{-0.85/0.1}}{e^{-0.85/0.1} + e^{-0.15/0.1}} =$	$P(\square/y_s) = \frac{e^{-0.15/0.1}}{\mathcal{D}} =$
---	--

COULEURS GAMUT



ComputerArts.de

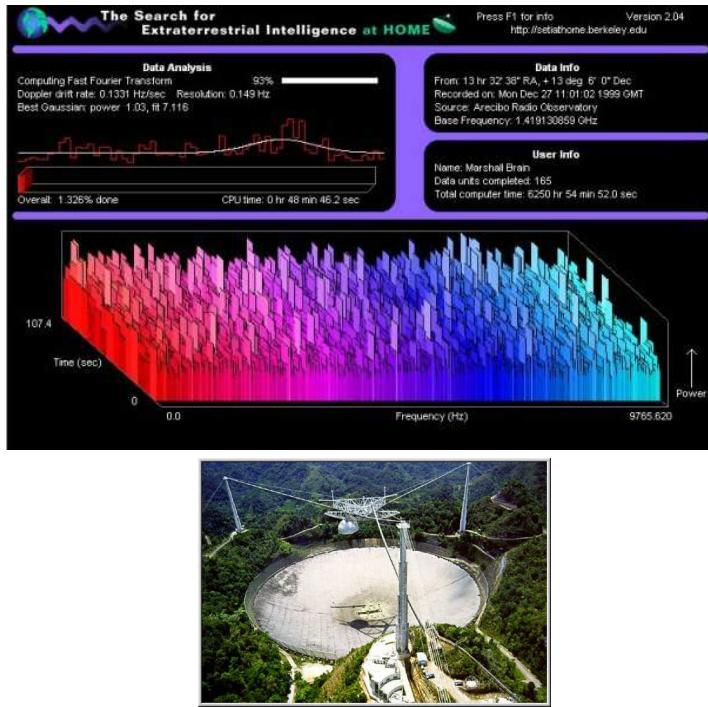
COULEURS
CUBE RGB



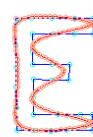
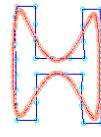
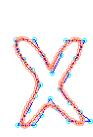
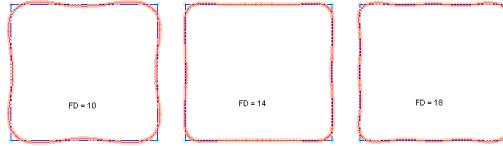
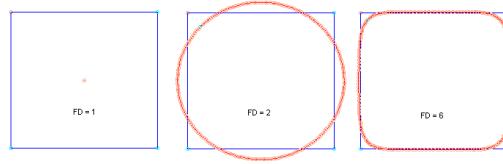
COMPRESSION
DCT

$$\mathbf{TCD} \left(\begin{array}{|c|} \hline \text{ } \\ \hline \end{array} \right) = \mathbf{TFD} \left\{ \begin{array}{|c|c|} \hline \text{ } & \text{ } \\ \hline \text{ } & \text{ } \\ \hline \end{array} \right\}$$

RECONNAISSANCE DES FORMES PROJET SETI



RECONNAISSANCE DES FORMES DESCRIPTEUR DE FOURIER

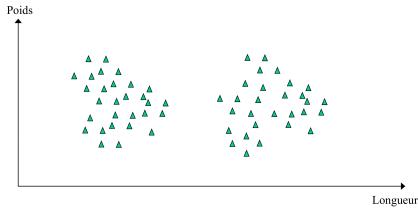


RECONNAISSANCE DES FORMES

ALGORITHME DES K-MOYENNES (1)

Algorithme des K-moyennes (*K-means*)

Exemple schématique de l'algorithme des K-moyennes

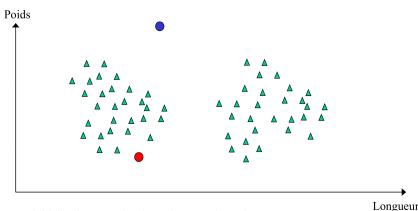


Voici 60 observations. Comment faire pour grouper ces données en deux classes et estimer la moyenne (ou le centre de masse) de ces classes ?

36

Algorithme des K-moyennes (*K-means*)

Exemple schématique de l'algorithme des K-moyennes



On initialise le centre des deux classes au hasard ● ●

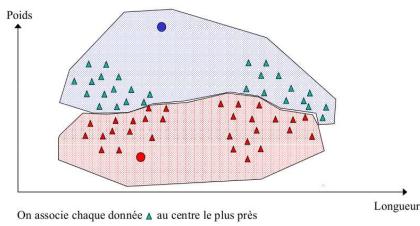
37

27

RECONNAISSANCE DES FORMES ALGORITHME DES K-MOYENNES (2)

Algorithme des K-moyennes (*K-means*)

Exemple schématique de l'algorithme des K-moyennes

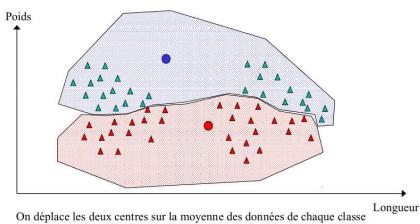


On associe chaque donnée \blacktriangle au centre le plus près

38

Algorithme des K-moyennes (*K-means*)

Exemple schématique de l'algorithme des K-moyennes



On déplace les deux centres sur la moyenne des données de chaque classe

39

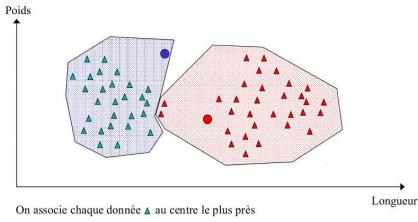
28

RECONNAISSANCE DES FORMES

ALGORITHME DES K-MOYENNES (3)

Algorithme des K-moyennes (*K-means*)

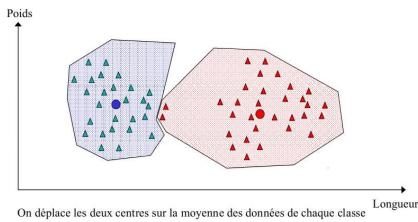
Exemple schématique de l'algorithme des K-moyennes



40

Algorithme des K-moyennes (*K-means*)

Exemple schématique de l'algorithme des K-moyennes



41

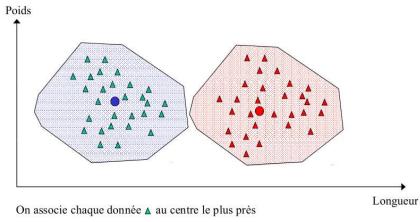
29

RECONNAISSANCE DES FORMES

ALGORITHME DES K-MOYENNES (4)

Algorithme des K-moyennes (*K-means*)

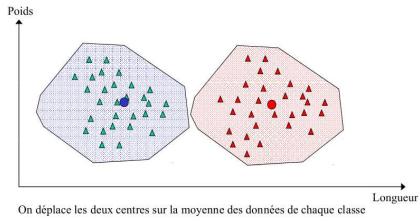
Exemple schématique de l'algorithme des K-moyennes



42

Algorithme des K-moyennes (*K-means*)

Exemple schématique de l'algorithme des K-moyennes



Lorsque l'algorithme converge, ● et ● correspondent à la moyenne de chaque classe

43

30







