

Objectifs du cours

- **Introduction au domaine de l'imagerie satellitaire :**
 - Types de capteurs
 - Acteurs du domaine
 - Domaines d'application
- **Revisite et mise en oeuvre de certaines approches mathématiques :**
 - Analyse de Fourier et ses extensions non harmoniques
 - Approches probabilistes et markoviennes
 - Méthodes a contrario
 - Approches non locales
 - Optimisation convexe et discrète
 - Modèles parcimonieux
- **Co-conception optique/capteurs/traitement**

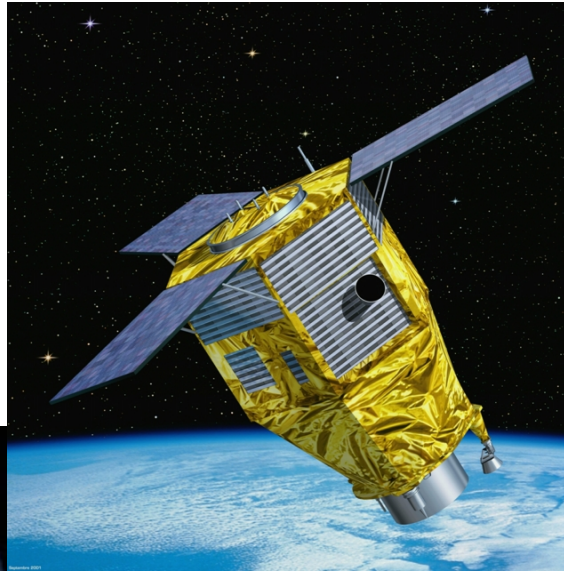


1 - Systèmes satellitaires optique / radar

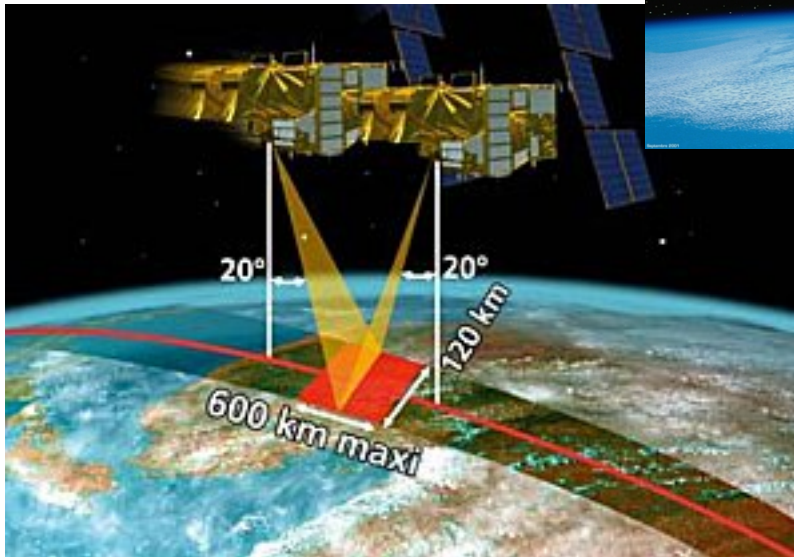
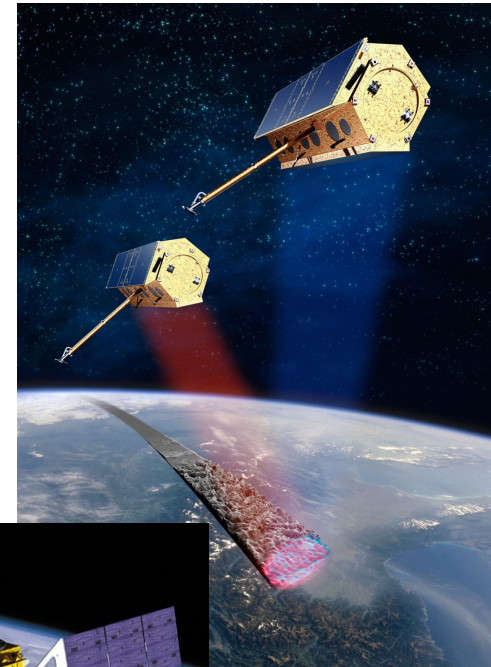


Pleiades
(dec 2011)

SPOT 5



TerraSAR & TanDEM



RadarSat2

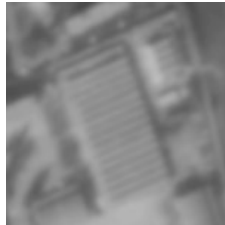


Restoration, antialiasing, interpolation

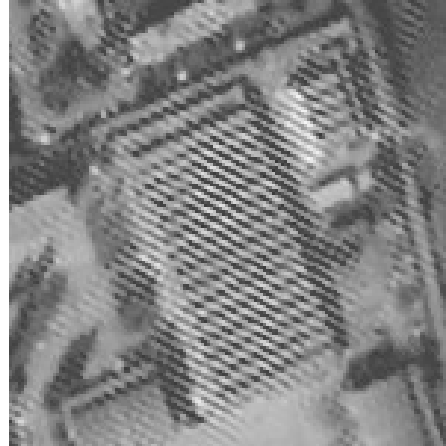
reference image f



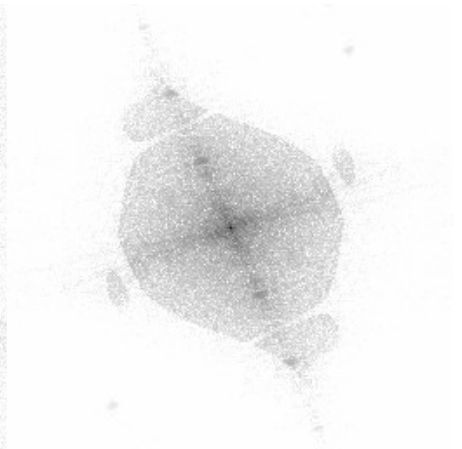
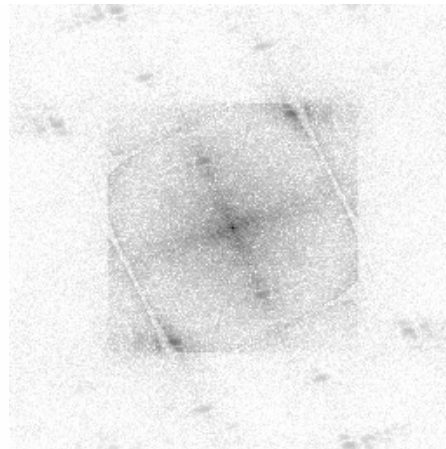
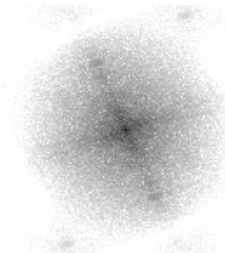
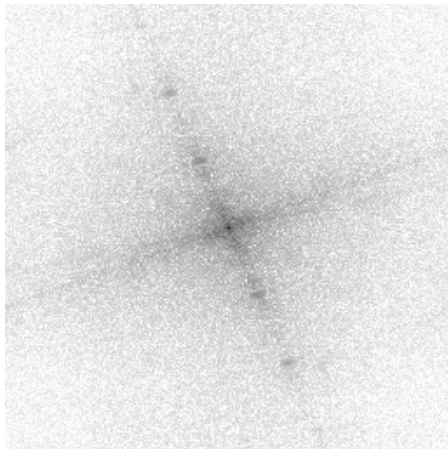
sampled image g



TV minimization with
data fit on $[-\frac{1}{2}, \frac{1}{2}]^2$



TV minimization with
data fit on D_{I-opt}^*



Echantillonnage irrégulier (microvibrations)



Image de référence u

QN+TV (Local constraints)



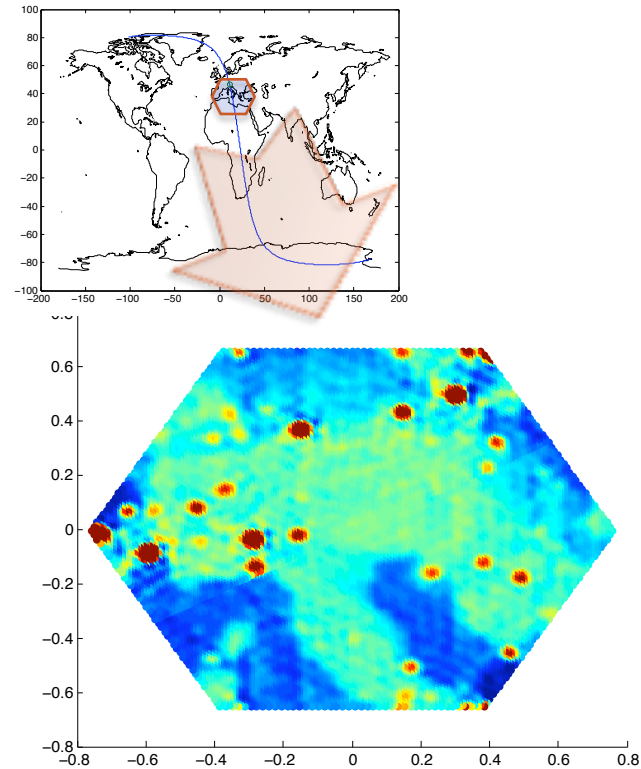
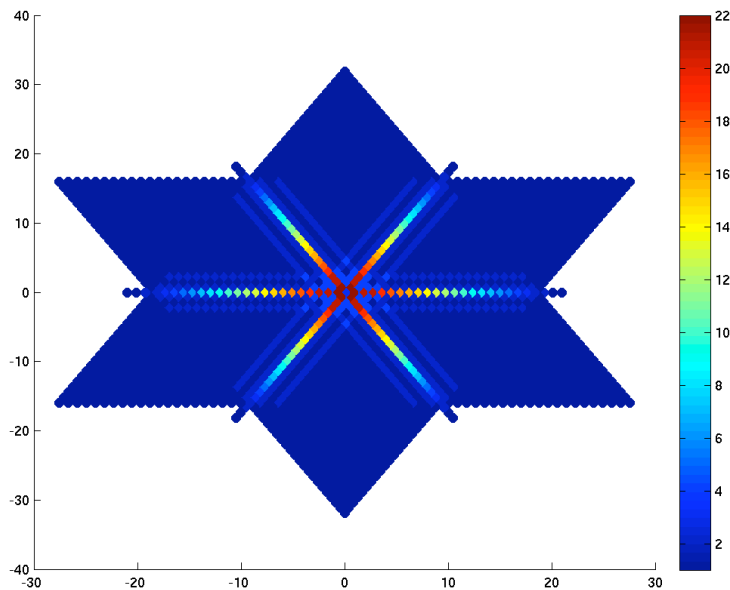
RMSE = 8.542



$$\begin{aligned} & \cdot (h * u) + n \\ & \text{upp}(\hat{\varepsilon}) \subseteq [-\frac{1}{20}, \frac{1}{20}]^2 \end{aligned}$$

Restauration SMOS

élimination de points aberrants

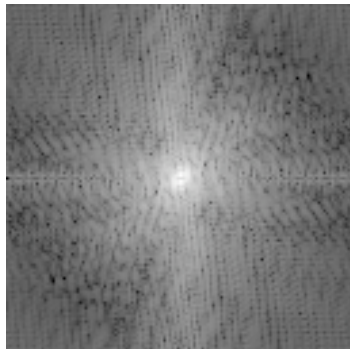


T_b obtenue par
Inversion de Fourier simple
(avec filtre linéaire de Blackmann)

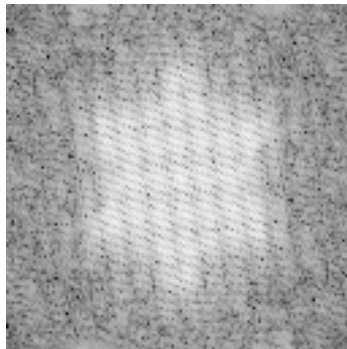
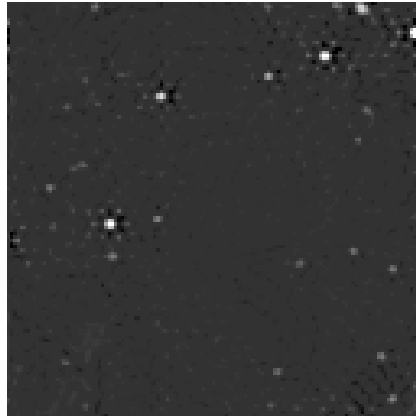
Restauration SMOS

élimination de points aberrants

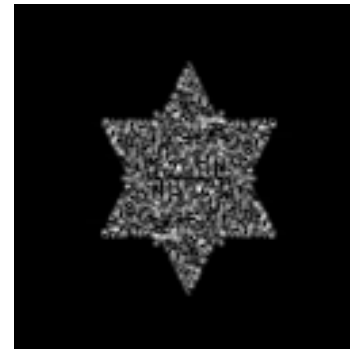
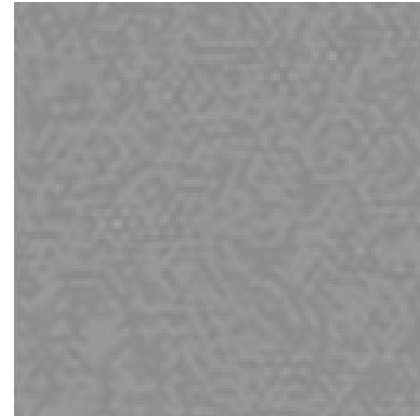
$u \in [28, 280]$



$o \in [-2000, 10000]$



$n \in [-150, 150]$



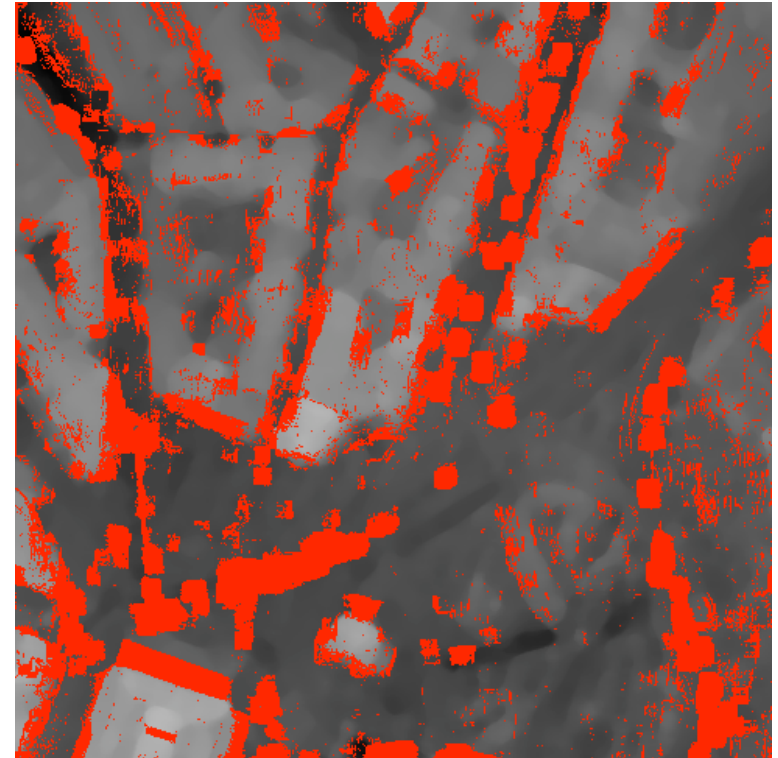
$$E(u, o) = \|W(F(o + u) - D)\|_2^2 + \lambda_0 \text{TV}(u) + \lambda_1 \|o\|_1.$$

Méthodes *a contrario* pour la Mise en correspondance stéréoscopique

Marseille



Paire stéréo
Gris = luminance



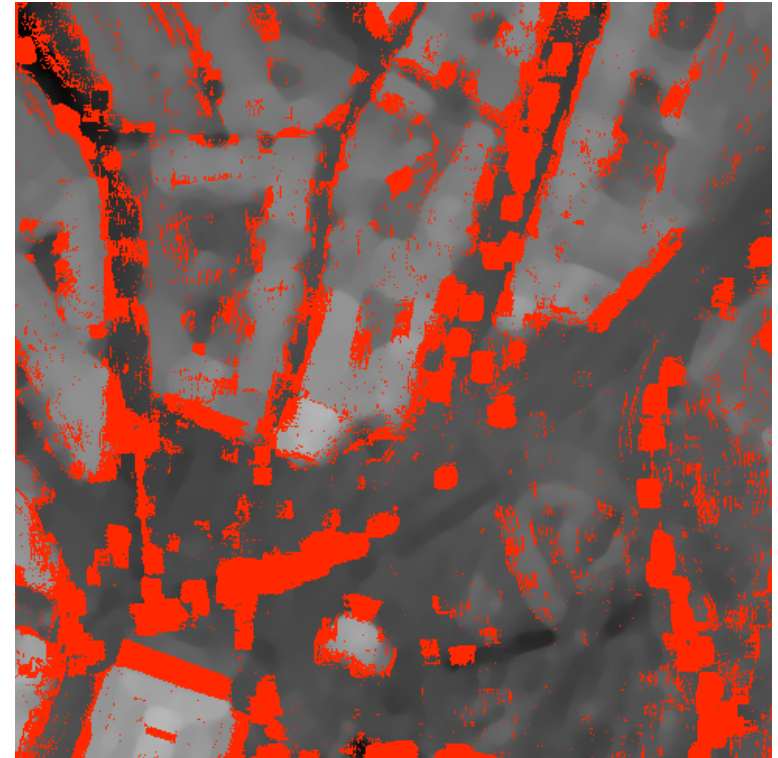
Gris = disparité
Rouge = non-validé (indécidable)

Méthodes *a contrario* pour la Mise en correspondance stéréoscopique

Marseille

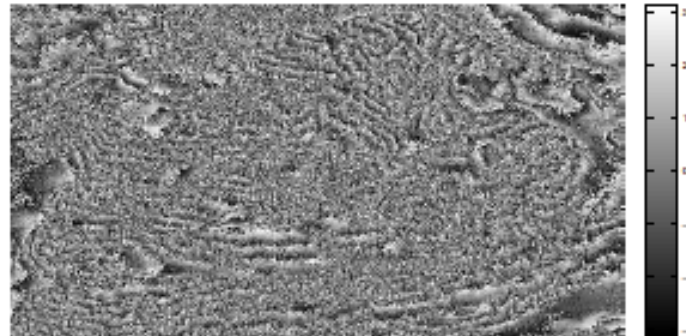
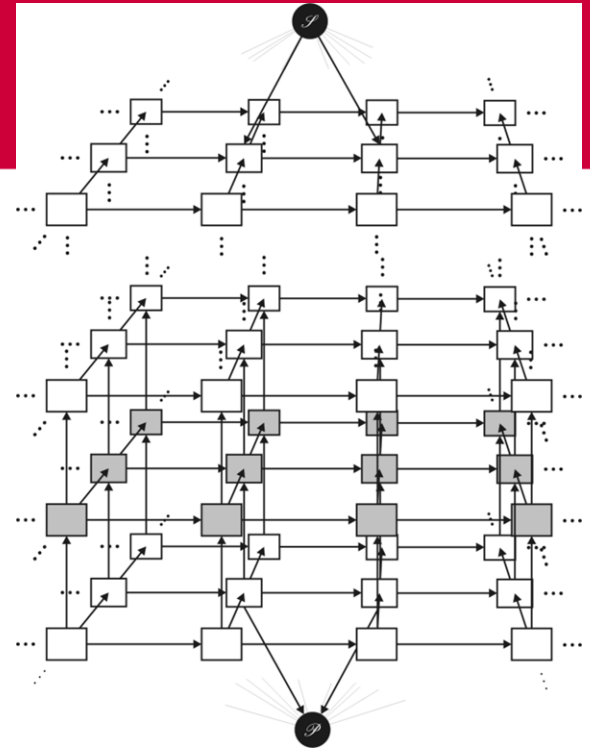
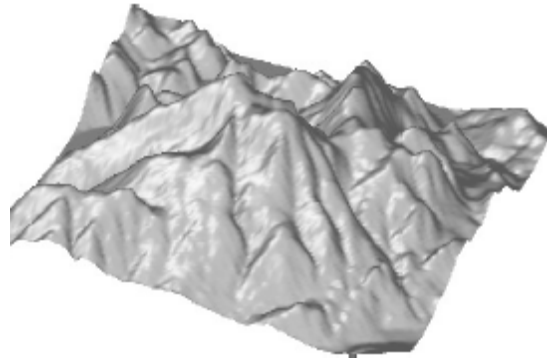


Paire stéréo
Gris = luminance



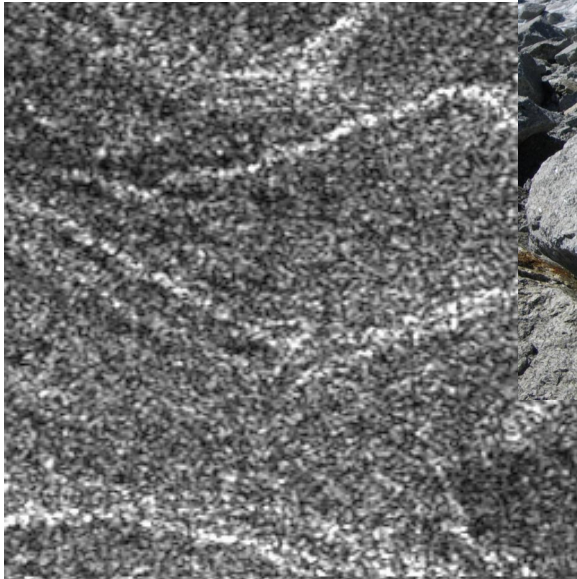
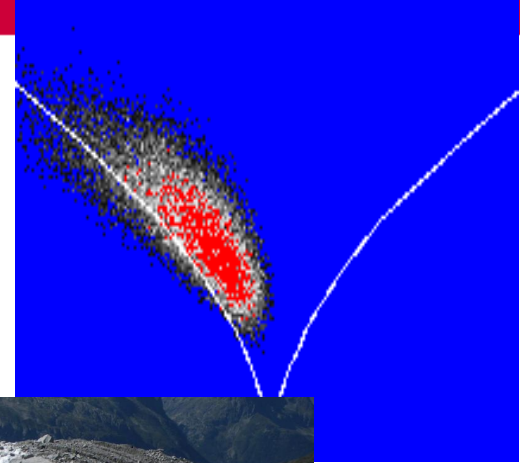
Gris = disparité
Rouge = non-validé (indécidable)

Modèles Markoviens et optimisation (graph-cuts)



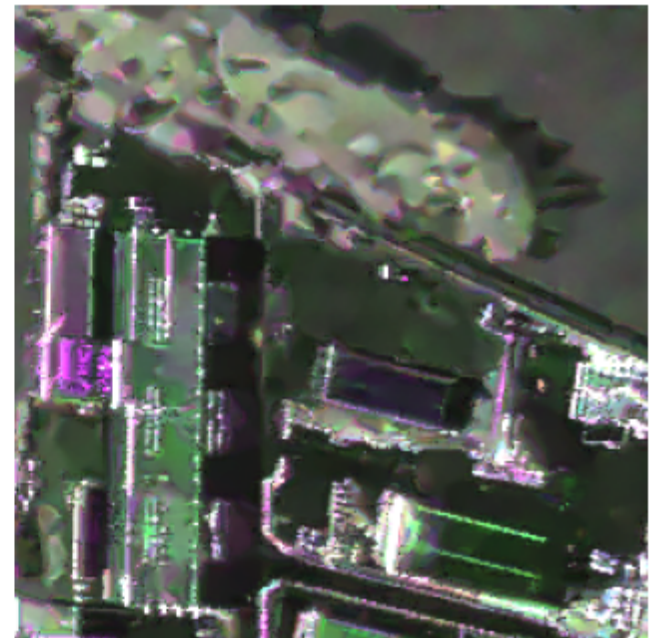
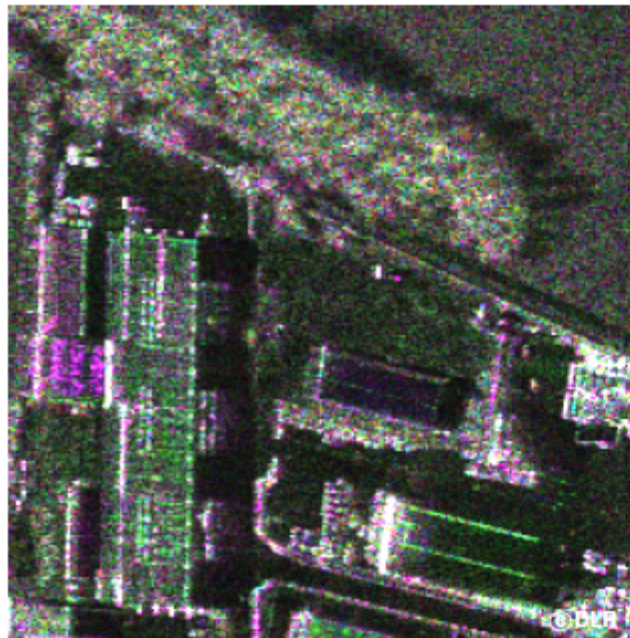
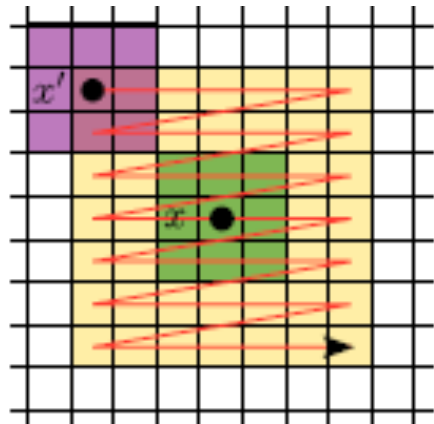


Organisation du cours





Méthodes non-locales probabilistes





Organisation du cours

■ Lieu des cours:

- Telecom ParisTech, 46 rue Barrault, 75013 Paris
- **Salles à confirmer**
- Vendredis de 14 à 17 heures
- Du 13 janvier au 31 mars

■ Structure du cours

- 1 cours d'introduction à la physique des systèmes satellitaires (JM Nicolas / A. Almansa)
- 3 cours + 1 TP sur l'imagerie optique (A. Almansa)
- 3 cours + 1 TP sur l'imagerie radar (F. Tupin)
- 1 cours sur l'ouverture codée (Y. Tendero)
- 1 séance de présentation des projets

■ Evaluation

- Projets individuels ou en binôme
- Rapports de TP + exercices

■ Plus de détails

<https://mvaisat.wp.mines-telecom.fr/>





Merci!

■ **Venez nombreux!**