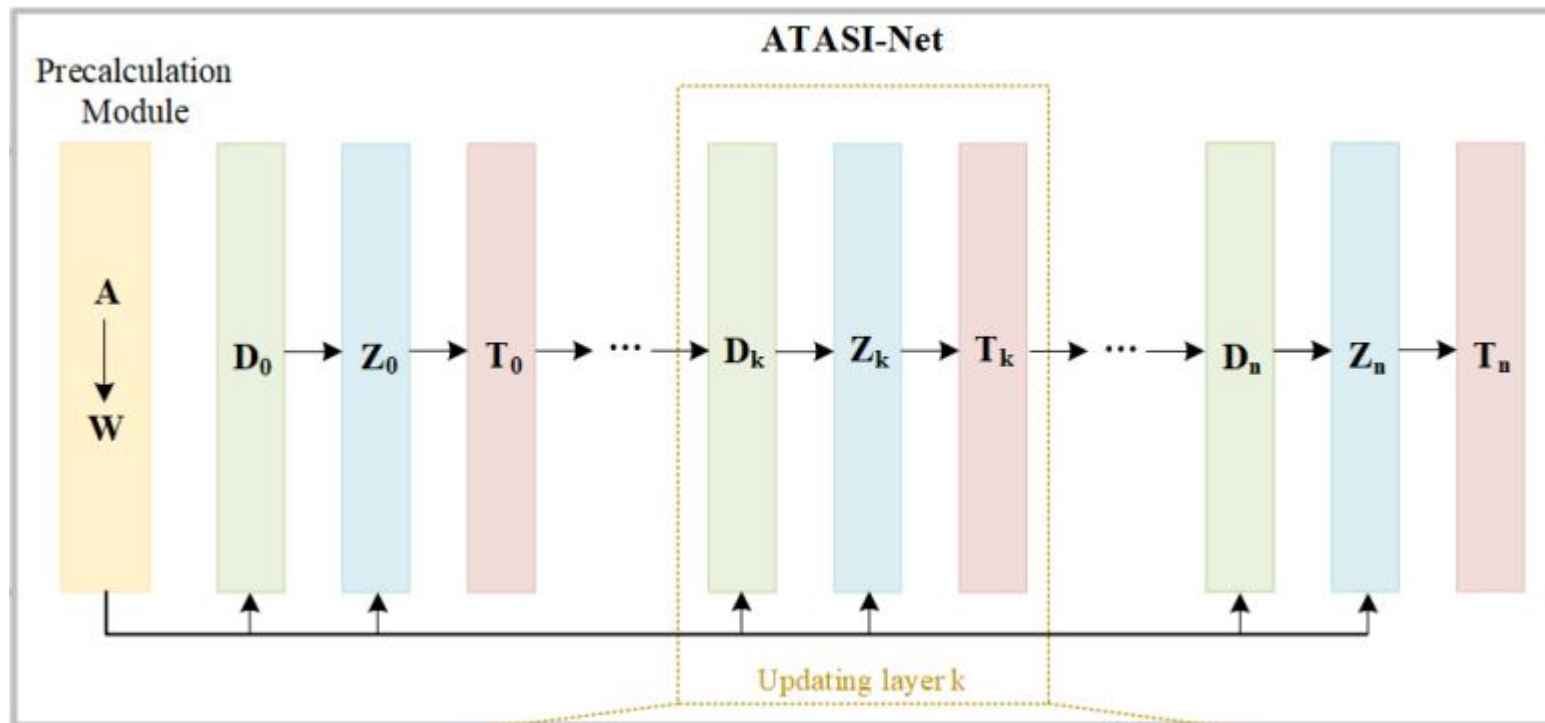


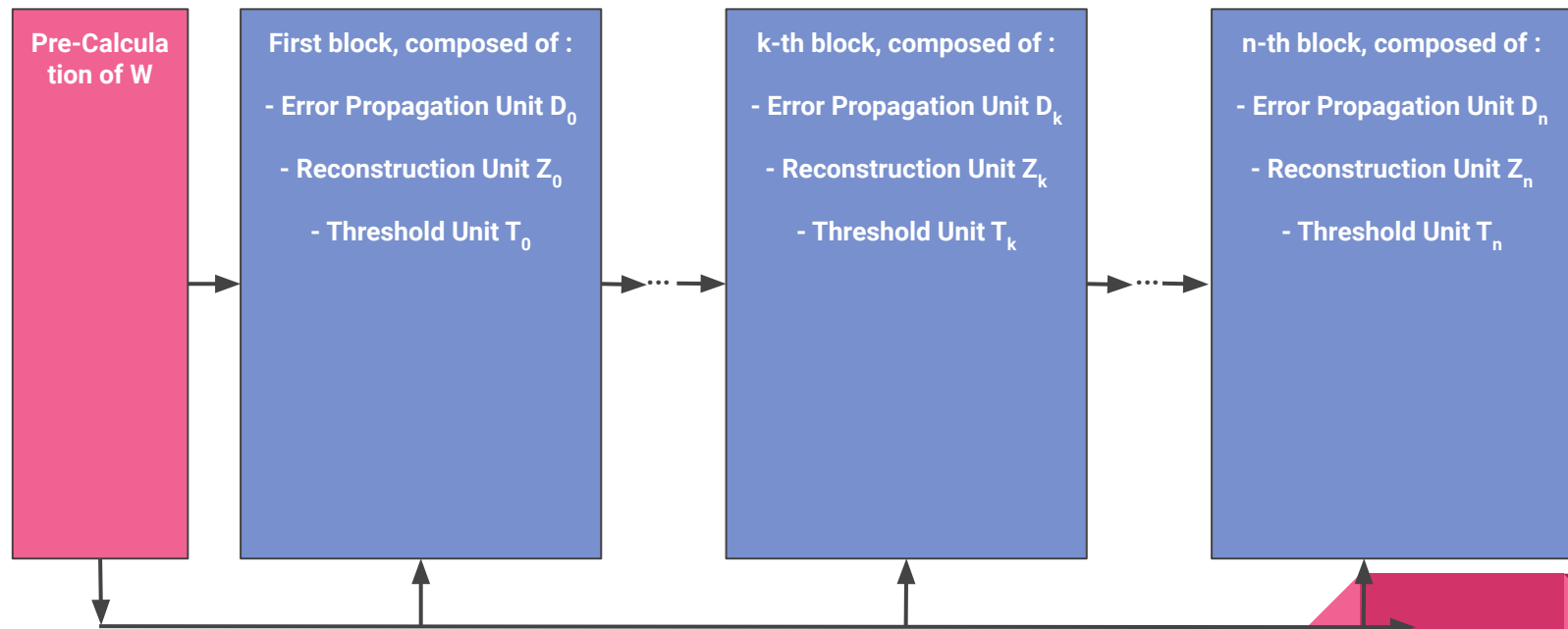
ATASI-Net Architecture

Reconstruction Network for TomoSAR Imaging

Isaya ESCANDE, Thomas MOULIN, Colin PICOLET



For a n layer network



Pre-Calculation of W

Pre-Calculation of W

Solves the minimization problem :

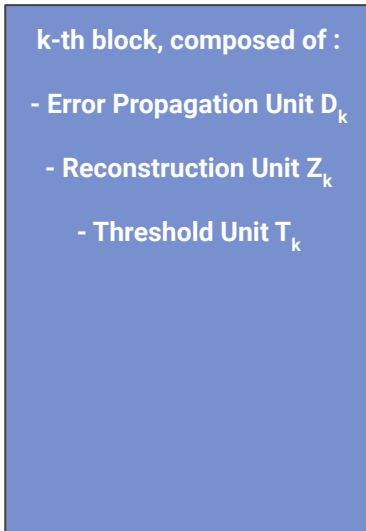
$$\arg \min_{W \in \mathbb{C}^{M \times N}} ||W^T A||^2 \text{ s.t. } (W_{:,i})^T A_{:,i} = 1$$

Where A is given by : $A_{nl} = \exp(j4\pi b_n s_l / \lambda r_0)$

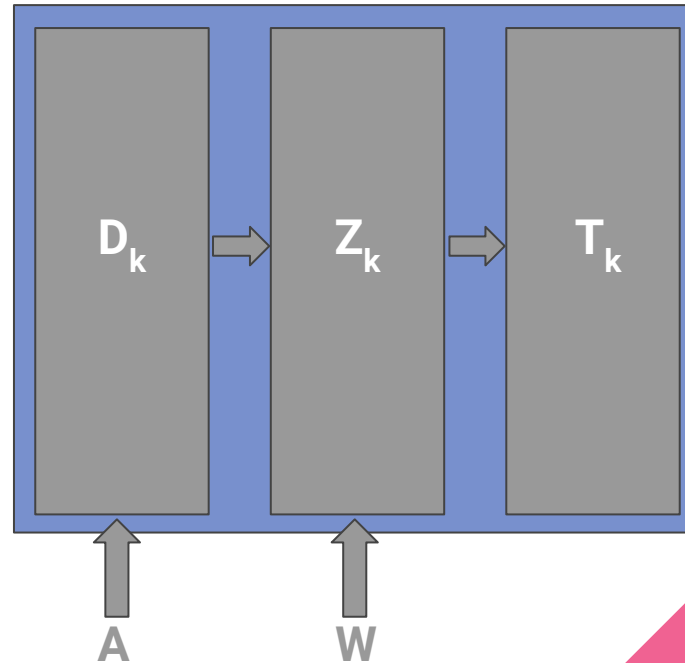
With s_l the elevation, b_n the baseline length of the n-th observation, λ the wavelength of the emitted signal, (x_0, r_0) a pixel.

For the k-th block we have simply $W_k = \beta_k W$

One Block



=

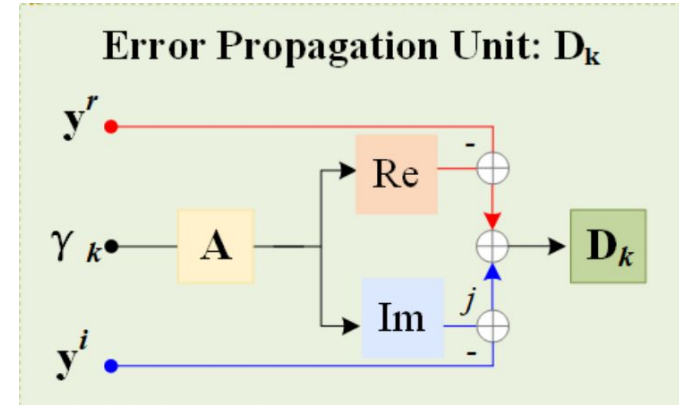


Error Propagation Unit D_k

$$D_k = A\gamma_k - y$$

The value computed estimates the error, and allows to then build an estimated reconstruction in the next module.

γ_k is the distribution of the scattering coefficients



Reconstruction Unit

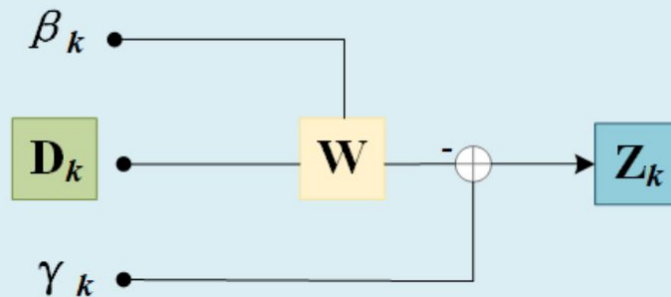
A two-step process to reconstruct an estimation γ_{k+1} , using the error D_k , the previous estimate γ_k and the weight matrix W_k .

First : $z^{k+1} = \gamma^k - W_{:,i}^k D^k$, with $W_{:,i}^k = \beta^k W_{:,i}$

Then the estimate is given by :

$$\gamma^{k+1} = \eta_{\theta_{k+1}}(z^{k+1})$$

Reconstruction Unit: Z_k



η

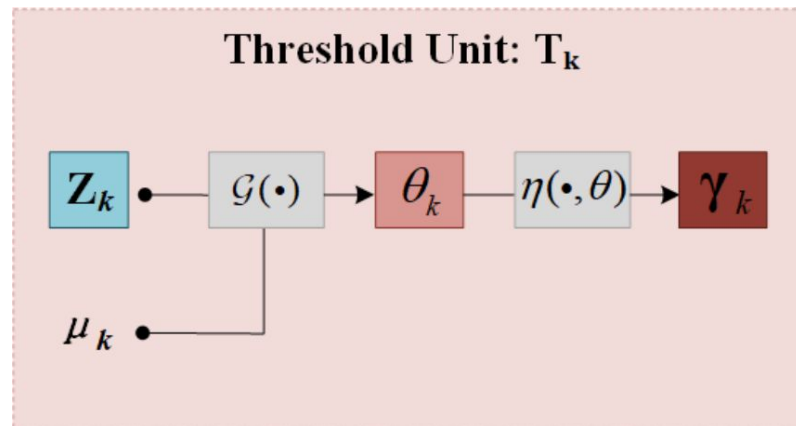
Thresholding Unit

θ_i^{k+1} is an element-wise shrinkage thresholding operator, meaning it is trained to use a different value to threshold each element differently.

$$\theta_i^{k+1} = \mu^k / (|z_i^{k+1}| + \epsilon)$$

ϵ is set to 0.01 according to previous studies.

μ^k is a learnable parameter (?)



Intérêt de la méthode par rapport à la littérature

Avantages :

- Entraînement de paramètres
 - Eviter le fine-tuning
- Selon ALISTA
 - la matrice des poids est résolues comme la solution d'un problème d'optimisation
 - le step size et paramètres de threshold sont appris des données
 - threshold adaptatifs au lieu de non-adaptatifs

Gamma-Net :

- Énorme quantité de paramètres
 - Complexité et temps de calcul
- Énorme dataset
 - Difficile pour du SAR
- Performance bonne en super résolution et estimation d'élévation

