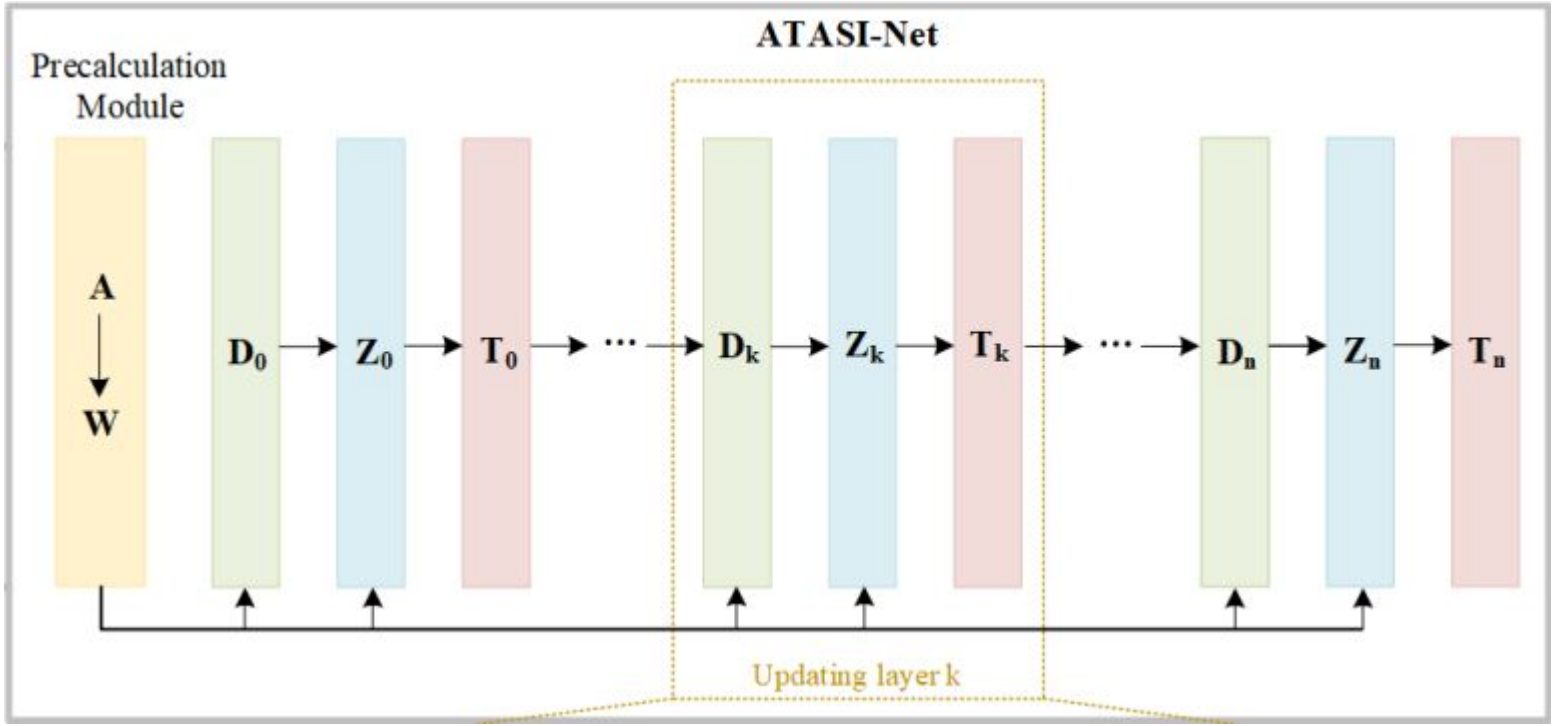
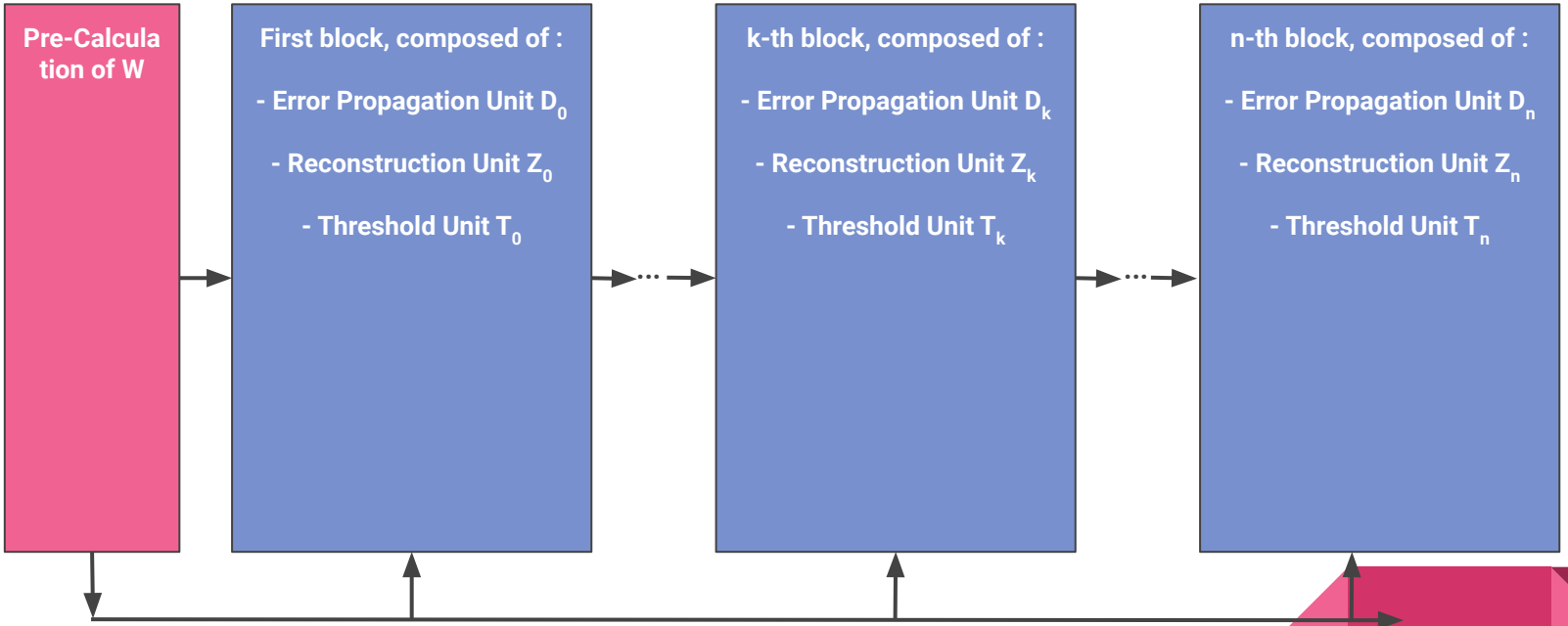
ATASI-Net Architecture

Reconstruction Network for TomoSAR Imaging


ATASI-Net
Precalculation Module
A
W
D0
Z0
T0
Dk
Zk
Tk
Dn
Zn
Tn
Updating layer k

For a n layer network



Pre-Calculation of W

Pre-Calculation of W

Solves the minimization problem :

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

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

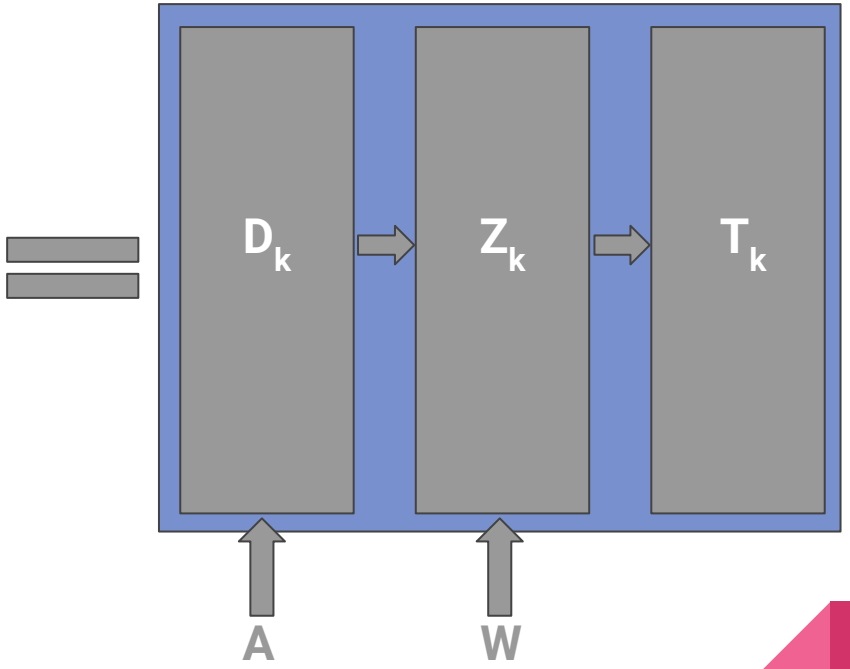
With s_l the elevation, b_n the baseline length of the n-th observation, λ the wavelength of the emitted signal, (x_0, r_0) a pixel.

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

One Block

k-th block, composed of :

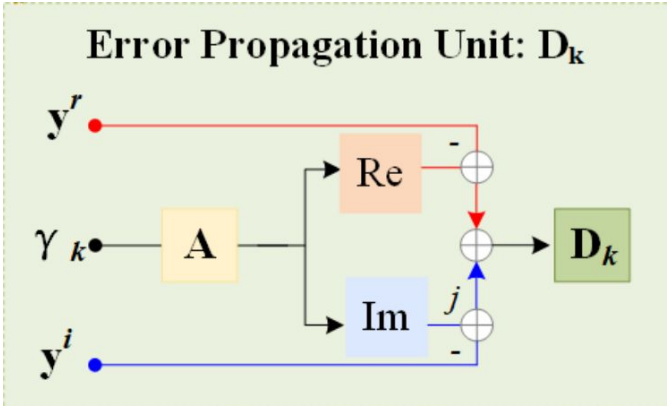
- Error Propagation Unit D_k
- Reconstruction Unit Z_k
- Threshold Unit T_k



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

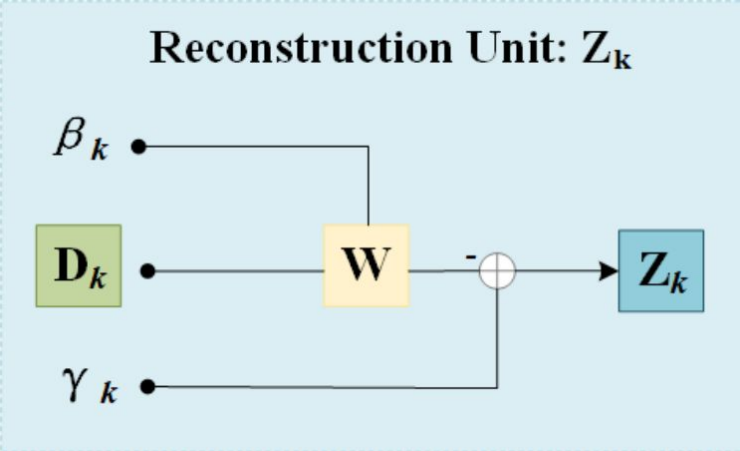


Reconstruction Unit

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 :
$\gamma^{k+1} = \eta_{\theta\_k+1}(z^{k+1})$



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.

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

ε is set to 0.01 according to previous studies.
μ^k is a learnable parameter (?)