SAR2SAR: A Semi-Supervised Despeckling Algorithm for SAR Images

Authors

Emanuele Dalsasso[1]
Florence Tupin[1]
Loïc Denis[2]

[1]*LTCI, Télécom Paris, Institut Polytechnique de Paris, France*

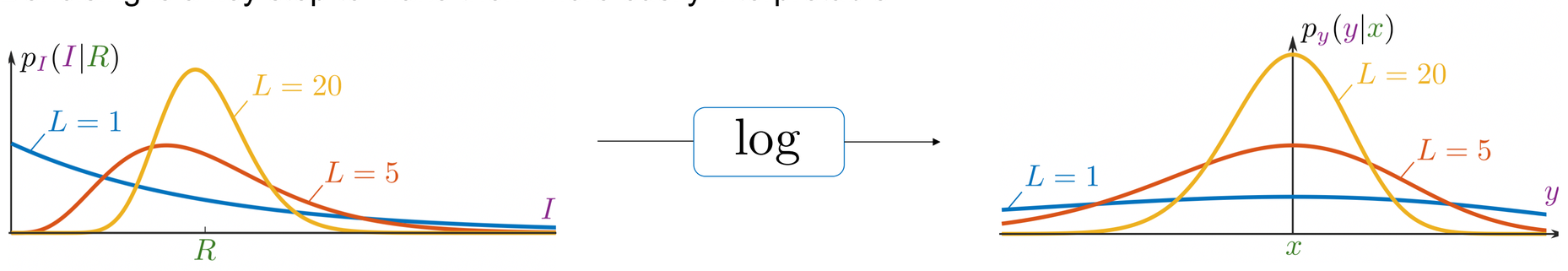
[2]*Univ Lyon, UJM Saint-Etienne, CNRS, Institut d'Optique Graduate School, Laboratoire Huber Curien, Saint-Etienne, France*

CONTEXT

- Synthetic Aperture Radar (SAR) sensors allow a continuous coverage of Earth's surface and are used in many applications, among which: urban monitoring, biomass estimation, land use mapping, damage prevention and assessment

SPECKLE MODEL

- SAR images are characterized by strong fluctuations, modeled as a multiplicative noise called *speckle*. Denoising is a key step to make them more easily interpretable.

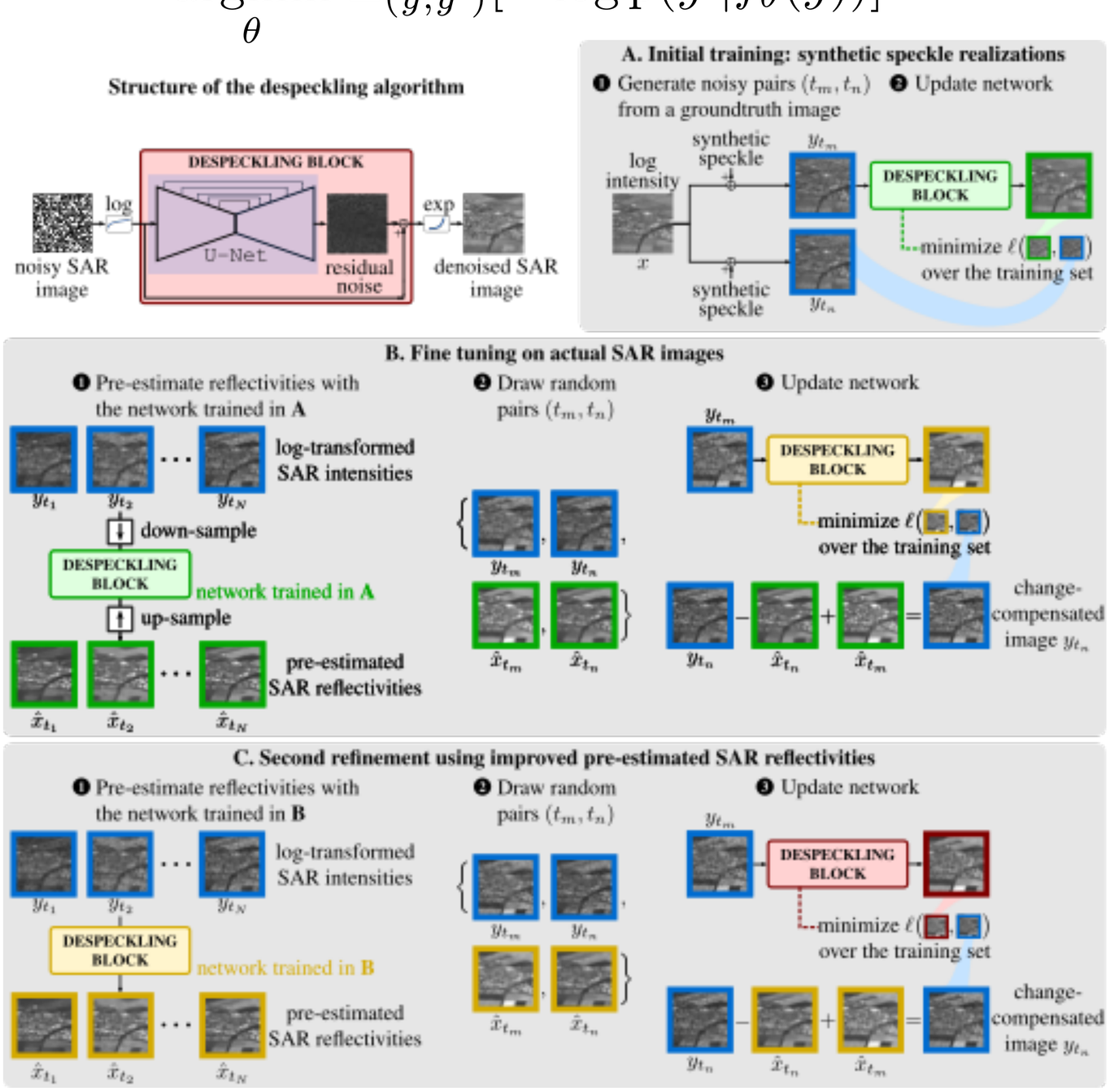


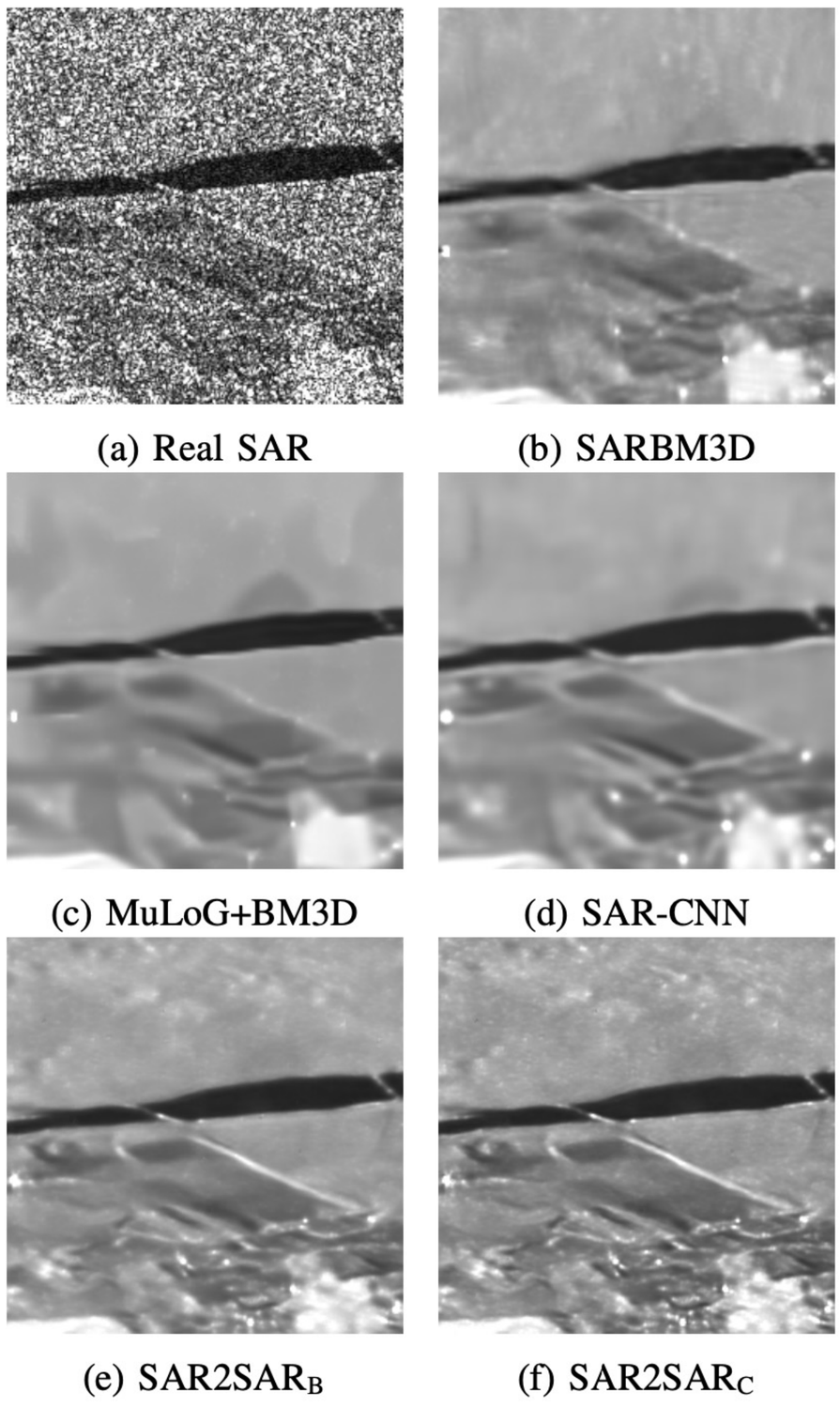
$$I = R \times S \qquad y = x + s$$

TRAINING STRATEGIES WITH SEMI-SUPERVISION: SAR2SAR

- Noise-free reference images do not exist
- Speckle spatial correlations are specific to the sensor acquisition process, limiting the use of simulation-based strategies
- The proposed training strategy relies entirely on real SAR images. A deep Convolutional Neural Network (CNN) is trained to optimize the likelihood of the noise model

$$\underset{\theta}{\operatorname{argmin}}\ \mathbb{E}_{(y,y')}[-\log \mathrm{p}(y'|f_\theta(y))]$$





(a) Real SAR (b) SARBM3D (c) MuLoG+BM3D (d) SAR-CNN (e) SAR2SAR_B (f) SAR2SAR_C

Results of state-of-the art despeckling filters on a real Sentinel-1 SAR image. (a) Real SAR. (b) SARBM3D (c) MuLoG+BM3D (d) SAR-CNN (e) SAR2SAR_B (f) SAR2SAR_C

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Contact emanuele.dalsasso@telecom-paris.fr Site web https://perso.telecom-paristech.fr/dalsasso/