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Si	**01**-Suzanne Lyons and David Sandwell. (2003). ***Fault creep along the southern San Andreas from interferometric synthetic aperture radar, permanent scatterers, and stacking.*** JOURNAL OF GEOPHYSICAL RESEARCH, 108, 1-24.	Interferometric synthetic aperture radar (InSAR) provides a practical means of mapping creep along major strike-slip faults. The small amplitude of the creep signal (<10 mm/yr), combined with its short wavelength, makes it difficult to extract from long time span interferograms, especially in agricultural or heavily vegetated areas. We utilize two approaches to extract the fault creep signal from 37 ERS SAR images along the southern San Andreas Fault. First, amplitude stacking is utilized to identify permanent scatterers, which are then used to weight the interferogram prior to spatial filtering. This weighting improves correlation and also provides a mask for poorly correlated areas. Second, the unwrapped phase is stacked to reduce tropospheric and other short-wavelength noise. This combined processing enables us to recover the near-field (200 m) slip signal across the fault due to shallow creep. Displacement maps from 60 interferograms reveal a diffuse secular strain buildup, punctuated by localized interseismic creep of 4–6 mm/yr line of sight (LOS, 12–18 mm/yr horizontal). With the exception of Durmid Hill, this entire segment of the southern San Andreas experienced right-lateral triggered slip of up to 10 cm during the 3.5-year period spanning the 1992 Landers earthquake. The deformation change following the 1999 Hector Mine earthquake was much smaller (<1 cm) and broader than for the Landers event. Profiles across the fault during the interseismic phase show peak-to-trough amplitude ranging from 15 to 25 mm/yr (horizontal component) and the minimum misfit models show a range of creeping/locking depth values that fit the data.
No totalmente	**02**-Parker J., Glasscoe M., Donnellan A., Stough T., Pierce M., Wang J. (2018) ***Radar Determination of Fault Slip and Location in Partially Decorrelated Images***. In: Zhang Y., Goebel T., Peng Z., Williams C., Yoder M., Rundle J. (eds) Earthquakes and Multi-hazards Around the Pacific Rim, Vol. I. Pageoph Topical Volumes. Birkhäuser, Cham https://doi.org/10.1007/s00024-016-1403-z Radar Determination of Fault Slip and Location in Partially Decorrelated Images Keywords Radar interferometry fault slip computer vision Canny algorithm	Faced with the challenge of thousands of frames of radar interferometric images, automated feature extraction promises to spur data understanding and highlight geophysically active land regions for further study. We have developed techniques for automatically determining surface fault slip and location using deformation images from the NASA Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), which is similar to satellite based SAR but has more mission flexibility and higher resolution (pixels are approximately 7 m). This radar interferometry provides a highly sensitive method, clearly indicating faults slipping at levels of 10 mm or less. But interferometric images are subject to decorrelation between revisit times, creating spots of bad data in the image. Our method begins with freely available data products from the UAVSAR mission, chiefly unwrapped interferograms,coherence images, and flight metadata. The computer vision techniques we use assume no data gaps or holes; so a preliminary step detects and removes spots of bad data and fills these holes by interpolation and blurring. Detected and partially validated surface fractures from earthquake main shocks, aftershocks, and aseismicinduced slip are shown for faults in California, including El MayorCucapah (M7.2, 2010), the Ocotillo aftershock (M5.7, 2010), and South Napa (M6.0, 2014). Aseismic slip is detected on the San Andreas Fault from the El Mayor-Cucapah earthquake, in regions of highly patterned partial decorrelation. Validation is performed by comparing slip estimates from two interferograms with published ground truth measurements.
Si	**03**-Xiang, Y.; Wang, F.; Wan, L.; You, H. ***SAR-PC: Edge Detection in SAR Images via an Advanced Phase Congruency*** Model. *Remote Sens.* **2017**, *9*, 209.	Edge detection in Synthetic Aperture Radar (SAR) images has been a challenging task due to the speckle noise. Ratio-based edge detectors are robust operators for SAR images that provide constant false alarm rates, but they are only optimal for step edges. Edge detectors developed by the phase congruency model provide the identification of different types of edge features, but they suffer from speckle noise. By combining the advantages of the two edge detectors, we propose a SAR phase congruency detector (SAR-PC). Firstly, an improved local

		energy model for SAR images is obtained by replacing the convolution of raw image and the quadrature filters by the ratio responses.Secondly, a new noise level is estimated for the multiplicative noise. Substituting the SAR local energy and the new noise level into the phase congruency model, SAR-PC is derived. Edge response corresponds to the max moment of SAR-PC. We compare the proposed detector with the ratio-based edge detectors and the phase congruency edge detectors. Receiver Operating Characteristic (ROC) curves and visual effects are used to evaluate the performance. Experimental results of simulated images and real-world images show that the proposed edge detector is robust to speckle noise and it provides a consecutive edge response.
No	**04**-G. Ferraioli, ***"Multichannel InSAR Building Edge Detection,"*** in IEEE Transactions on Geoscience and Remote Sensing, vol. 48, no. 3, pp. 1224-1231, March 2010.doi: 10.1109/TGRS.2009.2029338	"In this paper, the problem of building edge detection in synthetic aperture radar images is addressed. A new stochastic approach based on local Gaussian Markov random field (LGMRF) is proposed. The algorithm finds the edges of buildings starting from the estimation of the hyperparameters of the LGMRF model. The hyperparameters are seen as an indicator of the spatial correlation between adjacent pixels. The procedure is applied on interferometric data, using single-channel and multichannel configurations. The algorithm has been tested on simulated and real data, providing good results in both cases."
No	***05-****F. Baselice, G. Ferraioli and V. Pascazio,* ***"Man-made structure edge detector using a single Cosmo-SKYMED Spotlight image,"*** *2012 IEEE International Geoscience and Remote Sensing Symposium, Munich, 2012, pp. 6645-6648.* doi: 10.1109/IGARSS.2012.6352075 **keywords: {edge detection;geophysical image processing;remote sensing by radar;synthetic aperture radar;man made structure edge detector;Cosmo-SKYMED spotlight image;Spotlight Synthetic Aperture Radar;SAR Images;Image edge detection;Detectors;Synthetic aperture radar;Signal processing algorithms;Buildings;Periodic structures;Urban areas;SAR Edge Detection;Markov Random Fields;Cosmo-SKYMED Spotlight configuration},** URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6352075&isnumber=6350328	"In this work an edge detector for man made structures within Spotlight Synthetic Aperture Radar (SAR) Images is proposed. The algorithm processes both real and imaginary parts of the data and so it is able to fully exploit the acquired image, being optimal from the information theory point of view. The detector has been tested on Cosmo-SKYMED (CSK) Spotlight image and compared to other single image edge detectors, showing interesting and promising results."
si	***06-*** Wei Meng,Sandwell David ,Fialko Yuri and Bilham Roger . (2010). **Slip on faults in the Imperial Valley triggered by *the 4 April 2010***	Surface slip triggered by nearby earthquakes is common on faults in the Salton Trough region of Southern California [Rymer et al., 2002], a regional pull-apart basin formed at a releasing step over between major right-lateral faults associated with the Pacific and the North American

	Mw 7.2 El Mayor-Cucapah earthquake revealed by InSAR. GEOPHYSICAL RESEARCH LETTERS, 38, 6.	plate boundary (Figure 1) [Elders et al., 1972]. The “trough” is filled with sediments mainly from the Colorado River and surrounded by Mesozoic basement rocks and Tertiary volcanic rocks [Dorsey, 2010]. Previous studies have documented triggered slip on faults in the Imperial Valley during more than 8 earthquakes in the last 50 years [Hudnut et al., 1989; Rymer et al., 2002]. Between earthquakes steady surface creep on these faults occurs at rates of a few mm/yr, interrupted by episodic creep events [Rymer et al., 2002; Wei et al., 2009]. Sieh and Williams [1990] infer an association between shallow creep in unconsolidated sediments with inferred high pore pressures. Marone et al. [1991] and Du et al. [2003] provide a theoretical basis for both steady creep and episodic creep events along the respective faults.They show that in response to steady loading, a velocity- strengthening zone in the uppermost 3 km can host creep events, whose occurrence time may be advanced by shaking during the passage of seismic waves.[3] In this study we document triggered slip on faults in the Imperial Valley associated with the 4 April 2010 El Mayor-Cucapah Mw 7.2 earthquake using radar interferometry (InSAR) imagery, field surveys, and creepmeter data. Co-seismic offsets occurred on more than ten faults in this area. We estimate the depth of the triggered slip on the Superstition Hills Fault using dislocation modeling. We find that the results are consistent with previous inferences that slip extends only through the uppermost few kilometers roughly corresponding to the basement depth (3–5 km) [Wei et al., 2009]. The study illustrates that InSAR is an effective tool for measuring small fault offsets. Finally, we discuss the implications for the long-term slip budget. Comprehensive accounts of triggered slip are potentially important for slip budget analysis in the Imperial Valley region as well as seismic hazard assessment.
si	**07**-Canny, J. (1986). A computational approach to edge detection. IEEE Transactions on Pattern Analysis and Machine Intelligence, 6, 679–698.	“-This paper describes a computational approach to edge detection. The success of the approach depends on the definition of a comprehensive set of goals for the computation of edge points. These goals must be precise enough to delimit the desired behavior of the detector while making minimal assumptions about the form of the solution. We define detection and localization criteria for a class of edges,and present mathematical forms for these criteria as functionals on the operator impulse response. A third criterion is then added to ensure that the detector has only one response to- a single edge. We use the criteria in numerical optimization to derive detectors for several common image features, including step edges. On specializing the analysis to step edges, we find that there is a natural uncertainty principle between detection and localization performance, which are the two main goals.”

no	**08**-F. Baselice, G. Ferraioli, and V. Pascazio, "**Building edge detection from sar amplitude and phase data,"** in Urban Remote Sensing Event (JURSE), 2011 Joint, april 2011, pp. 193 -196.	"Building edge detection exploting Synthetic Aperture Radar (SAR) multi-channel data is a research topic of increasing importance in years. The basic idea of the presented algorithm is to estimate edges using jointly both SAR amplitude and phase data. The technique exploits also Markov Random Field (MRF) theory. A correlation map, from which building edges are detected, is computed using both phase and reflectivity map (i.e. using the amplitude and the phase of SAR images). Respect to amplitude based edge detectors and to phase based ones, the proposed method shows better performances in terms of detection accuracy and false alarm rate. The algorithm is tested on simulated data, showing its effectiveness."
NO	**09.**A. B. Suksmono, A. Handayani and A. Hirose, "**Snake in Phase Domain: A Method for Boundary Detection of Objects in Phase Images**," The 2006 IEEE International Joint Conference on Neural Network Proceedings, Vancouver, BC, 2006, pp. 481-485. doi: 10.1109/IJCNN.2006.246720 keywords: {edge detection;gradient methods;object detection;phase domain;boundary object detection;phase images;modulo-2pi field;gradient vector field;snake dynamics;unwrapped phase;modulo-2pi gradient estimation;Object detection;Phase detection;Synthetic aperture radar interferometry;Image segmentation;Minimization methods;Magnetic resonance imaging;Image processing;Image converters;Spline;Image edge detection;snake algorithm;gradient vector flow;energy minimization algorithm;phase image;modulo-2 regularization;InSAR;MRI;phase unwrapping}, URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1716131&isnumber=36115	"This paper presents a snake algorithm for boundary detection of objects in phase images. Since phase image is a modulo-2pi field, the proper gradient vector field (GVF) for snake dynamics should be taken from an unwrapped phase. This paper proposes a procedure to avoid such unwrapping by applying modulo-2pi gradient estimation. Performance assessment is conducted by comparing a boundary detection result of non-modulo-2pi GVF snake estimate with a modulo-2pi regularized GVF snake. It is shown that the proposed method converges to the expected boundary, while the non-regularized procedure does not."
No	**10.**V. P. Onana, E. Trouve, G. Mauris, J. P. Rudant and E. Tonye, **"Thin linear features extraction in SAR images by fusion of amplitude and coherence information,"** IGARSS 2001. Scanning the Present and Resolving the Future. Proceedings. IEEE 2001 International Geoscience and Remote Sensing Symposium	In this paper, we propose a new method to extract thin linear decorrelated features in SAR interferometric images by fusioning the information provided by the amplitude and the coherence. A first detection is the result of an unsupervised classification performed on the coherence image, where linear features correspond to dark areas (low coherence) and non-linear features to brighter areas. This approximate location of the linear features is further refined by using edge information extracted in the amplitude data by two measures: the coefficient of variation (CV) and the ratio of local means (RLM). A precise detection is then performed by using the results of coherence

	(Cat. No.01CH37217), Sydney, NSW, Australia, 2001, pp. 3012-3014 vol.7. doi: 10.1109/IGARSS.2001.978238 keywords: {hydrological techniques;geophysical techniques;terrain mapping;cartography;geophysical signal processing;remote sensing by radar;synthetic aperture radar;radar imaging;image classification;feature extraction;geophysical measurement technique;cartography;land surface;terrain mapping;radar imaging;radar remote sensing;thin linear feature;feature extraction;image processing;linear decorrelated features;SAR interferometry;InSAR;coherence image;image classification;coefficient of variation;ratio of local means;fusion;Cameroon;river networks;mangrove;hydrology;SAR;synthetic aperture radar;amplitude;coherence;Feature extraction;Image edge detection;Data mining;Performance evaluation;Pixel;Low-frequency noise;Equations;Decorrelation;Rivers;Satellites}, URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=978238&isnumber=21051	classification and the fusion of the two previous measures. The method has been applied on ERS SAR images from the western part of Cameroon to extract thin river networks in mangrove areas. The goal is to update - or create geographical maps.
si	**11** Cai, Jiehua & Wang, Changcheng & Mao, Xiaokang & Wang, Qi-jie. (2017). **An Adaptive Offset Tracking Method with SAR Images for**	With the development of high-resolution Synthetic Aperture Radar (SAR) systems, researchers are increasingly paying attention to the application of SAR offset tracking methods in ground deformation estimation. The traditional normalized cross correlation (NCC) tracking method is based on regular matching windows. For areas with different moving characteristics, especially the landslide boundary areas, the NCC method will produce incorrect results. This is because in landslide

	Landslide Displacement Monitoring. Remote Sensing. 9. 830. 10.3390/rs9080830.	boundary areas, the pixels of the regular matching window include two or more types of moving characteristics: some pixels with large displacement, and others with small or no displacement. These two kinds of pixels are uncorrelated, which result in inaccurate estimations. This paper proposes a new offset tracking method with SAR images based on the adaptive matching window to improve the accuracy of landslide displacement estimation. The proposed method generates an adaptive matching window that only contains pixels with similar moving characteristics. Three SAR images acquired by the Jet Propulsion Laboratory's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) system are selected to estimate the surface deformation of the Slumgullion landslide located in the southwestern Colorado, USA. The results show that the proposed method has higher accuracy than the traditional NCC method, especially in landslide boundary areas. Furthermore, it can obtain more detailed displacement information in landslide boundary areas.
	12-Kobayashi, T., Takada, Y., Furuya, M., and Murakami, M. (2009), **Locations and types of ruptures involved in the 2008 Sichuan earthquake inferred from SAR image matching**, Geophys. Res. Lett., 36, L07302, doi:10.1029/2008GL036907.	[1] We have detected detailed ground displacements in the proximity of the Longmen Shan fault zone (LMSFZ) by applying a SAR offset-tracking method in the analysis of the 2008 Sichuan earthquake. An elevation-dependent correction is indispensable for achieving sub-meter accuracy. A sharp displacement discontinuity with a relative motion of ∼1–2 m appears over a length of 200 km along the LMSFZ, which demonstrates that the main rupture has proceeded on the Beichuan fault (BF) among several active faults composing the LMSFZ, and a new active fault is detected on the northeastward extension of the BF. The rupture on the BF is characterized by a right-lateral motion in the northeast, while in the southwest an oblique right-lateral thrust slip is suggested. In contrast to the northeast, where a major rupture proceeded on the BF only, in the southwest multiple thrust ruptures have occurred in the southeastern foot of the Pengguan massif.
Si ver link https://www.researchgate.net/publication/228879924_An_edge_de	**13**. Joshi, M. , Merry, C. J., Jezek, K. C. and Bolzan, J. F. (2001), **An edge detection technique to estimate melt duration, season and melt extent on the Greenland Ice Sheet using Passive Microwave Data**. Geophys. Res. Lett., 28: 3497-3500. doi:10.1029/2000GL012503	The melt extent, duration and melt season on the Greenland ice sheet were estimated using an edge detection technique on passive microwave data from the SSM/I and SMMR instruments (18/19V GHz channel) for the period 1979 to 1997. The annual brightness temperature (Tb) time series at a pixel location that experiences summer melt has a steep rise and drop in Tb with the onset and end of melt, respectively. A derivative-of-Gaussian edge detector is used to detect edges corresponding to the onset and end of melt. The time lapsed between the first upward and last downward edge on the annual Tb time series gives an estimate of the melt season and the time lapsed between

tection_technique_to_estimate_melt_duration_season_and_melt_extent_on_the_Greenland_Ice_Sheet_using_Passive_Microwave_Data		successive upward and downward edges gives the duration of melt. While the maximum melt extent increased by 18%, the total duration of melt increased by 3.7% and the total melt season decreased by 3.8% during the period 1979–1997.
no	14.K. Fu, Y. Zhang, X. Sun, W. Diao, B. Wu and H. Wang, "**Automatic building reconstruction from high resolution InSAR data using stochastic geometrical model,"** 2016 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Beijing, 2016, pp. 1579-1582. doi: 10.1109/IGARSS.2016.7729403 keywords: {buildings (structures);feature extraction;image reconstruction;radar imaging;stochastic processes;synthetic aperture radar;fully automatic building reconstruction method;high resolution interferometric synthetic aperture radar data;InSAR data;stochastic geometrical model;building detection procedure;building clips;image	In this paper, a fully automatic building reconstruction method for high resolution interferometric synthetic aperture radar (InSAR) data is presented. This method is based on stochastic geometrical model. Firstly, a building detection procedure is implemented on the big image and the entire scene is divided into building clips. After that, the reconstruction process is utilized for each building clip. In the reconstruction process, a building in 3D space is projected to the image plane and then decomposed to feature regions including layover, corner line, roof and shadow. We explore the statistic properties of the each region, and include it in the posterior function, together with the edge term and the prior we defined. Finally, in order to overcome local optima, a group of special transmission kernels are designed. The experimental results on TanDEM-X data demonstrate the effectiveness of our method.

	plane;feature regions;statistic properties;posterior function;edge term;special transmission kernels;TanDEM-X data;Buildings;Image reconstruction;Kernel;Synthetic aperture radar;Feature extraction;Optimization;Image resolution;Automatic Building Reconstruction;Interferometric Synthetic Aperture Radar (InSAR);Top-Down Scheme}, URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7729403&isnumber=7728980	