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STEREO IMAGING WITH SPACEBORNE RADARS

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Stereo viewing is a valuable tool in photointerpretation and used for the quantitative reconstruction of the three-dimensional shap topographical surface.

Stereo derives from the greek word "stereos" (hard, solid). viewing refers to a visual perception of space by presenting an overl image pair to an observer so that a three-dimensional model is formed brain. Some of the observer`s function can be performed by ma correlation of the overlapping images - so called automated stereo lation. The direct perception of space with two eyes is often called n binocular vision; techniques of generating three-dimensional models c surface from two sets of monocular image measurements is the top stereology.

Stereo viewing of side-looking radar images has been a top discussion since 1963, when La Prade (1963) reported on first experi The most commonly discussed stereo imaging arrangements with radar have both flights at the same side or each of the two flights at opposite si the object. Other arrangements have been discussed in theory but hav materialized.

Satellite radar images have been produced in the Apollo 17 project of the Moon, in the Seasat-SAR and Space Shuttle SIR-A mission missions resulted in overlapping side-looking radar imagery suitabl stereo viewing. However, from orbits, the standard aircraft radar arrangements with parallel "same" or "opposite-side" stereo do not ex all times: a considerable portion of overlapping images is from non-pa flight lines.

All three past satellite-radar missions have been investigat their resulting variation of overlapping radar images for stereo vi These were used to obtain indications of the capabilities and limitati stereo radar. Apart from mere verification of the physiological s viewability there exists a requirement to evaluate its quality by nu This can be by defining an exaggeration factor and a reconstruction ac of the three coordinates. Both measures of quality were obtained fo satellite radar mission and are shown in Table 1.

The exaggeration factor is sometimes used in photogrammet compare the real base-to-height ratio of imaged objects with the vi perceived base-to-height relationship. This factor is thus a measu flatness of the stereo model: a value of zero is the flat reproduction surface; a value of 3-5 corresponds with results known in photography.

The accuracy is obtained by comparing object height differ
from radar measurements with those in nature. A wide range of values res
they indicate that the accuracy is so far not well suited for operat
topographic height mapping on Earth, with errors amounting to more than ±
(Leberl, 1979).

However, stereo radar height measurements can be of value in analyses that depend on control of topographic effects. A digital h model (DHM) is only rarely available for a study area and is difficul accurately register to a radar image. A DHM computed from stereo rada directly registered to the images and should be accurate enough to correc radar data for radiometric and geometric defects due to surface slopes.

Satellite radar images have been used to develop and demons correction techniques once a DHM is available; and they have addressed question of obtaining a DHM from radar images themselves. For this pu the images from SIR-A were of particular interest, since some typical novel radar stereo configurations were produced: flight lines intersec angles up to 35° and still permit one to obtain a valid stereo impress This set of data resulted in an experimental DHM obtained from overla SIR-A images alone.

The stereo viewability of radar image pairs cannot be investi in a convincing manner with the small variation of existing stereo configurations. The viewability depends on radar look angles, stereo in section angle, type of terrain and flight line arrangements. Most avail imagery is taken at similar, hardly variable look angles. To exploit the range of possibilities one can take advantage of image simulation. Sev initiatives have been developed recently, among them those of Kaupp et (1982) and of Leberl et al. (1982). Indications are that intersection an of 60° or so produce good stereo radar image pairs.

More work is required to expand radar image simulation: squi mode operation, intersecting flight lines, eccentric satellite orbits, and texture variation are needed to cover a wide range of potential satel radar parameters.

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Table 1. Exaggeration factors and height accuracy achieved with satellite radar (after correction polynomial was applied)

Radar mission	Look angle, deg	Intersection angle, deg	Flying height km	Exaggeration factor	Height accuracy, m	Com
Seasat	22	4.8	800	3.8	121	Gra mi
Apollo ALSE	10	1.9	116	17	150	
SIR-B	47	37	264	3.0	162	Cep fli int