The use of remote sensing imagery as auxiliary data in forest inventory is based on the correlation between features extracted from the images and the ground truth. The bidirectional reflectance and radial displacement cause variation in image features located in different segments of the image but forest characteristics remaining the same. The variation has so far been diminished by different radiometric corrections.

In this study the use of sun azimuth based converted image co-ordinates was examined to supplement auxiliary data extracted from digitised aerial photographs. The method was considered as an alternative for radiometric corrections. Additionally, the usefulness of multi-image interpretation of digitised aerial photographs in regression estimation of forest characteristics was studied. The state owned study area located in Leivonmäki, Central Finland and the study material consisted of five digitised and ortho-rectified colour-infrared (CIR) aerial photographs and field measurements of 388 plots, out of which 194 were relascope (Bitterlich) plots and 194 were concentric circular plots. Both the image data and the field measurements were from the year 1999.

When examining the effect of the location of the image point on pixel values and texture features of Finnish forest plots in digitised CIR photographs the clearest differences were found between front- and back-lighted image halves. Inside the image half the differences between different blocks were clearly bigger on the front-lighted half than on the back-lighted half. The strength of the phenomenon varied by forest category. The differences between pixel values extracted from different image blocks were greatest in developed and mature stands and smallest in young stands. The differences between texture features were greatest in developing stands and smallest in young and mature stands.

The logarithm of timber volume per hectare and the angular transformation of the proportion of broadleaved trees of the total volume were used as dependent variables in regression models. Five different converted image co-ordinates based trend surfaces were used in models in order to diminish the effect of the bidirectional reflectance. The reference model of total volume, in which the location of the image point had been ignored, resulted in RMSE of 1,268 calculated from test material. The best of the trend surfaces was the complete third order surface, which resulted in RMSE of 1,107. The reference model of the proportion of broadleaved trees resulted in RMSE of 0,4292 and the second order trend surface was the best, resulting in RMSE of 0,4270. The trend surface method is applicable, but it has to be applied by forest category and by variable.

The usefulness of multi-image interpretation of digitised aerial photographs was studied by building comparable regression models using either the front-lighted image features, back-lighted image features or both. The two-image model turned out to be slightly better than the one-image models in total volume estimation. The best one-image model resulted in RMSE of 1,098 and the two-image model resulted in RMSE of 1,090. The homologous features did not improve the models of the proportion of broadleaved trees. The overall result gives motivation for further research of multi-image interpretation. The focus may be improving regression estimation and feature selection or examination of stratification used in two-phase sampling inventory techniques.

The publication is available online at Ethesis-database, which is maintained by Helsinki University Library.