10

TARGET ABUNDANCE-CONSTRAINED MIXED PIXEL CLASSIFICATION (TACMPC)

The mixed pixel classification (MPC), which was considered in Chapters 8 and 9 is unconstrained with no constraint imposed on the target signature abundance fractions. Consequently, the resulting abundance estimates do not necessarily reflect their true amounts of abundance. In this case, these estimates can be only used for the purpose of target detection, discrimination and classification, but not for target quantification. In order for MPC to perform mixed pixel quantification, we need to consider a fully constrained mixed pixel classification problem, which imposes two constraints on the abundance fractions of target signatures. They were described in Chapter 3, (a) abundance sum-to-one constraint, referred to as ASC, $\sum_{j=1}^{p}\alpha_j = 1$ and (b) abundance nonnegativity constraint, $\alpha_j \geq 0$ for all $1 \leq j \leq p$, referred to as ANC. Since no closed form can be derived for a fully constrained mixed pixel classification problem, two least-squares approaches are presented in this chapter. One is referred to as fully constrained least-squares method (FCLS), which develops an efficient algorithm to yield least-squares optimal solutions. Another is referred to as modified fully constrained least-squares method (MFCLS), which applies the ASC, but replaces ANC with the absolute abundance sum-to-one constraint (AASC), i.e., $\sum_{j=1}^{p}\left|\alpha_j\right| = 1$, that allows one to derive an analytical form for optimal solutions. Both approaches arrive at nearly the same results. Additionally, both FCLS and MFCLS can be further extended to unsupervised methods by incorporating unsupervised algorithms presented in Chapter 5.