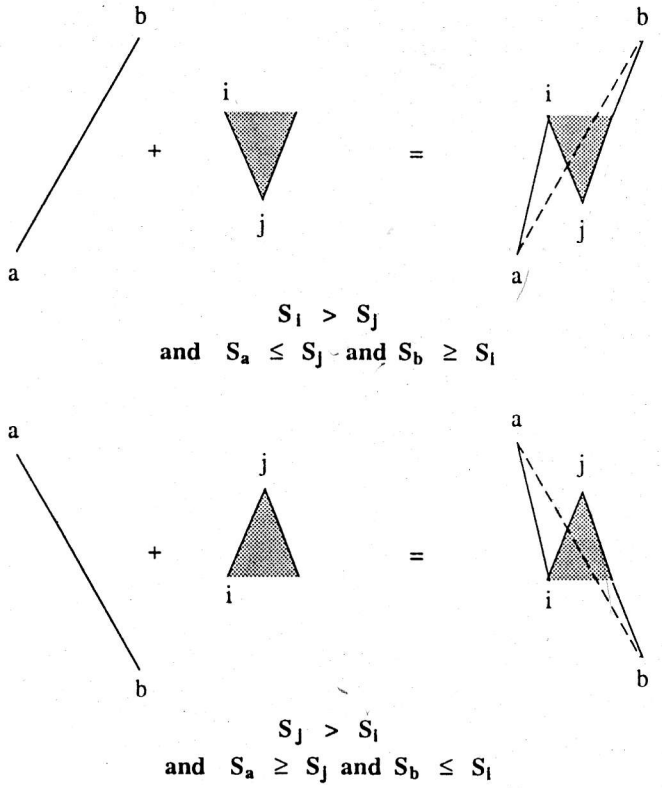

Figure 4 The two cases of inserting a cycle

According to these rules a cycle may be inserted in several different transitions. The reconstructed sequence is therefore not unique, as illustrated in *Figure 5*. First, the cycles to be inserted and the residue are presented. The cycle ABA′ may be inserted into transitions b–c, d–e or f–g; cycle DED′ into c–d, e–f or g–h; and the cycles GHG′ and JKJ′ can be inserted only in transition d–e. The reconstruction may be, for example, cycle ABA′ into transition b–c, DED′ into g–h, GHG′ into d–e and JKJ′ into the new transition d–G. *Figure 5* shows the reconstructed sequence obtained in this case.

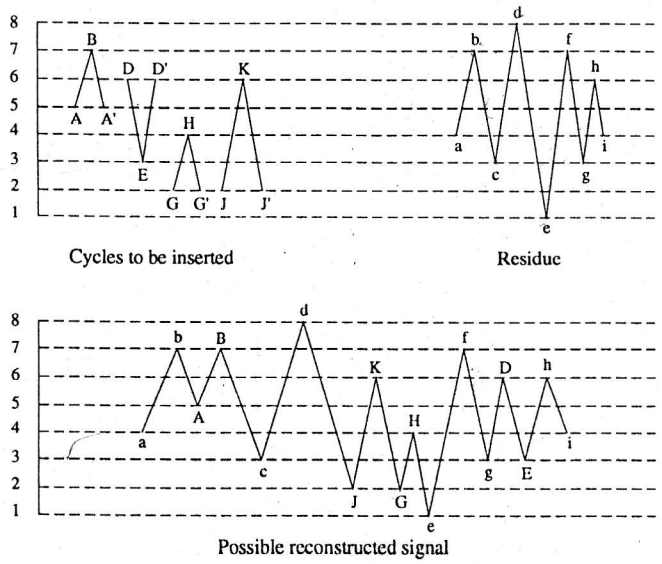

Figure 5 Example of reconstructed signal

When a cycle has been inserted, new possibilities may appear for the next cycles because of the new transitions that are created. Some possibilities for insertion may also disappear, as the newly formed transitions are of smaller range than the transition in which the cycle has been set up. In order to insert all the cycles of the sequence, the cycles of highest amplitude must be treated first. The rules for the reconstruction of a sequence lead to the algorithm presented in *Figure 6*.

Note that it is possible to obtain a sequence in which cycles of small amplitude are discarded without using a reconstruction technique. The rainflow procedure is applied to the sequence but only points corresponding to cycles with amplitude below a specified threshold are removed. This procedure cannot be applied for truncating high-amplitude cycles, as small cycles contained in the transitions of these high cycles cannot be connected to the remaining parts of the sequence.

Combination of sequences and rainflow counting results

If a signal is composed of several sequences placed side by side, the rainflow counting result does not in

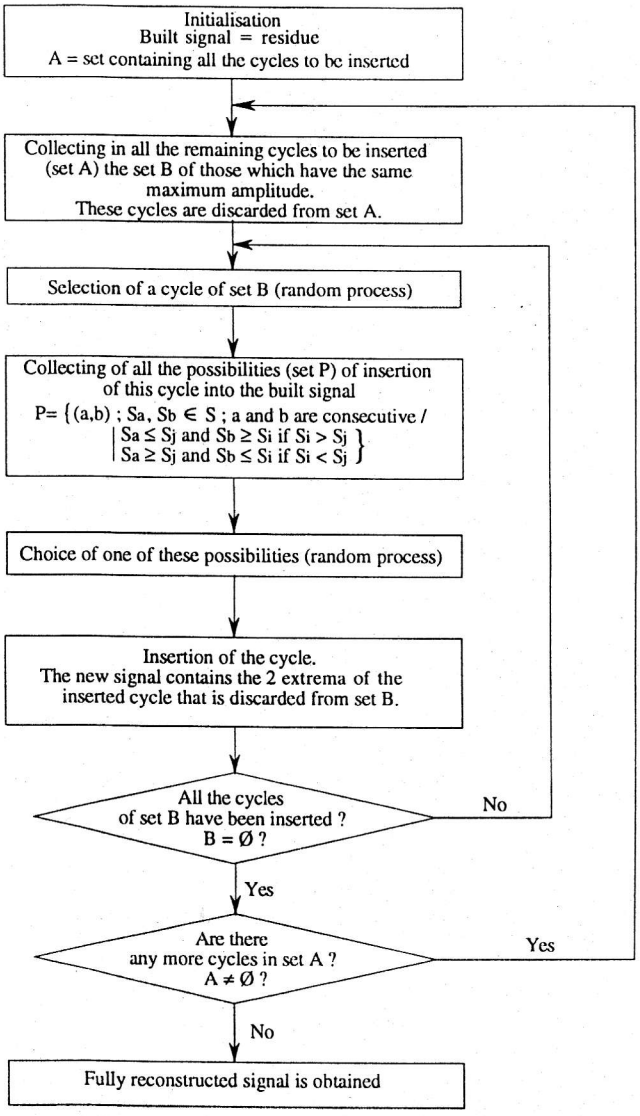

Figure 6 Proposed algorithm for reconstructing a signal