4.3 Convolution

In the previous part the convolution problem was used several times as a demonstrative example. First let's recall these results. The convolution of the following two signals:

$$u(i) \quad i = 0..(N-1) \quad \text{and} \quad w(i) \quad i = 0..(M-1) \quad \text{is defined by}$$

$$y(i) = \sum_{j=0}^{i} u(j)w(i-j) \qquad \text{if} \quad i = 0..(M-1) \quad \text{and} \tag{4.5}$$

$$y(i) = \sum_{j=i-M+1}^{N-1} u(j)w(i-j) \quad \text{if} \quad i = M..(N+M-2)$$

so the resulted sequence has $(N+M-1)$ elements.

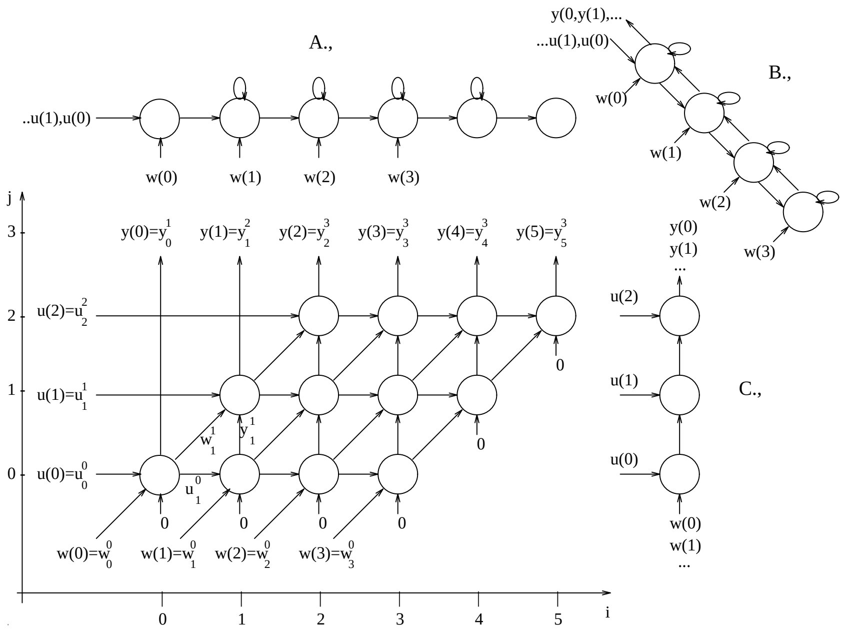

Figure 4.3: DG of convolution with SFG-s A., B., and C., projected with vectores $[0,1]$, $[1,1]$ and $[1,0]$ respectively

The locally recursive and single assigment form of convolution is:

$$y_i^{(j+1)} = y_i^{(j)} + u_i^{(j)} * w_i^{(j)} \tag{4.6}$$

$$u_{i+1}^{(j)} = u_i^{(j)}$$

$$w_{i+1}^{(j+1)} = w_i^{(j)}$$

where the index ranges are:
if $i = 0..(M-1)$ than $j = 0..i$ and
if $i = M..(N+M-2)$ than $j = (i-M+1)..(N-1)$
and the initial conditions are:
$y_i^{(0)} = 0$ for $i = 0..(M-1)$ and
$y_i^{(i-M+1)} = 0$ for $i = M..(N+M-2)$,
$u_k^{(k)} = u(k)$ for $k = 0..(N-1)$,
$w_k^{(0)} = w(k)$ for $k = 0..(M-1)$.

The connected DG is shown on figure 4.3, and it is locally recursive and homogenous, suited very well to array processor realization. The further step of parallel implementation are - mapping from DG to SFG, - mapping SFG to some parallel architecture.

In figure 4.3 some possible projections to SFG can be also find. The detailed description of these steps are beyond our possibilities so we only refer to the literature e.g. [Kung88].