PFB Upchannelisation Question

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From my understanding, given the time stream vector x, the telescope gives us $B^T x$, which is a coarser PFB, and we want Ax, which is the result of a fine PFB. The minimisation procedure gives us:

$$C = (B^T B + \tilde{Q})^{-1} B^T A, \tag{1}$$

which is the coefficient that we apply to $B^T x$ that gives us the fine PFB. So in the end, $CB^T x$ is the closest approximation we have to Ax.

If we run some numbers, however, it seems that the dimension won't match. Say that B^T is a 4-tap, $2n_c = 512$ PFB, and we want A as a 4-tap, $2n_c = 2048$ PFB. Then, A should be of dimension $1024 \times \dim x$, and B^T should be of dimension $256 \times \dim x$. Obviously, they couldn't multiply together, so Eq. (1) doesn't really compute.

I'm not quite sure about what you mean by using several blocks of the short PFB; do you mean that we cut the length of $B^T x$ to what we need?

Giving myself a hypothetical scenario

The below scenario also gives something wrong, and I hope that I didn't make any big mistake somewhere, but here's the scenario:

We have B^T that does the coarse PFB, which is 4-tap and n_{CB} channels. We also have A that does the fine PFB, which is also 4-tap and n_{CA} channels. We also have the relationship $n_{CA} = 4n_{CB}$ (we upchannelise by a factor of 4). Let the input time stream be denoted by $\boldsymbol{x}$, which is of length $\dim(\boldsymbol{x}) = 128n_{CB}$.

The first operation is $B^T x$. As a result, it is clear that B^T takes input of length $128n_{CB}$. Since it's a 4-tap PFB, the output would be of length $61n_{CB}$, if we move down $2n_{CB}$ indices every instance of the PFB. In other words, B^T is a matrix of size $61n_{CB} \times 128n_{CB}$

Now, we take $AB^T x$. Since $n_{CA} = 4n_{CB}$, after cutting off the end to make the input divisible, we have that the input that A takes is of dimension $60n_{CB} = 15n_{CA}$. Since the PFB is 4-tap, the first instance of PFB uses the first $8n_{CA}$ data, leaving $7n_{CA}$ for the further instances. Making it divisible by 2, we have $6n_{CA}$ left for the next few small PFBs, which in the end gives us an output dimension of $4n_{CA} = 16n_{CB}$. As a result, A is a matrix of size $16n_{CB} \times 60n_{CB}$.

This doesn't make sense, since when we feed the output back to B^T in the next step, the dimensions would be all wrong.