Fig. 2. Virtual array configuration

\[ v_{2,m}^{n}(\theta) = \begin{cases} \frac{1}{r_1} e^{j(2\pi/\lambda)(m-1)d\sin \delta_1^{(n-1)}} & (1 \leq m \leq 3) \\ \frac{1}{r_2} e^{j(2\pi/\lambda)(m-1)d\sin \theta} & (4 \leq m \leq 6) \end{cases} \]  

(24)

IV. SIMULATION RESULTS

In this section, we examine the localization performance of our proposed method. We use common simulation parameters over all simulations as Table II. The location of a source and each subarray is as Fig. 4. A source is generated in random to show the proposed method does not depend on the source location.

First, the phase synchronization between two subarrays is assumed as perfect. In other words, \( \delta_1, \delta_2 \) in eqs. (17) and (18) are exact. We compare the proposed method to three conventional methods. Conv. \((M \times K)\) means the conventional method that uses \( K \) subarrays each configured of \( M \) elements. Prop. is the proposed method that uses 2 subarrays each configured of 3 elements, the virtual array configuration of Prop. is based on method 4, and the iteration count \( n = 5 \). The purpose of our proposed method is to improve localization accuracy without increasing the number of antennas.

In Fig. 5, the RMSEs of the location estimates for all the methods versus SNR (signal to noise ratio) are shown. Prop. performs asymptotically close to Conv. \((6 \times 2)\) and Conv. \((6 \times 4)\), and outperforms Conv. \((3 \times 2)\). This is because Prop. can use more snapshots than Conv. \((3 \times 2)\). Prop. shows the more robustness, particularly in low SNR. We stress that Conv. \((6 \times 2)\) and Conv. \((6 \times 4)\) use more antennas than Prop..

In Fig. 6, the CDFs (cumulative distribution function) of location RMSEs at SNR = 0 dB versus the error distance, \(0.5^\circ\) intervals, are shown. The probability of Prop. in the small errors, less than \(1^\circ\), is higher than that of Conv. \((6 \times 2)\), whereas in the large errors, is also higher. In Prop., AOA is estimated by using the parameters (directions and distances) estimated in the previous iteration. Thus, the estimation errors in the \((n-1)\)th iteration are larger, the localization accuracy of Prop. in the \(n\)th iteration is also larger.

Fig. 7 and 8 show the MUSIC spectrum of the conventional method \((n = 1)\) and the proposed method \((n = 5)\). The maximum spectrum of the proposed method is closer to true AOA than that of the conventional method. At the same time, MUSIC spectra of the proposed method have spurious peaks because the proposed method in update estimation uses the snapshots of the other subarray. However, these spurious peaks are much lower than the maximum spectra, true peaks, then we can distinguish these peaks.

Next, we evaluate the effect of the phase synchronization error between two subarrays. Note that the phase synchron-