In the figure, two long straight wires carry currents directly out of the board. They are equal distances from the origin. To what value must \( i_1 \) be changed so that the magnetic field at the origin is rotated 20 degrees clockwise?

**Solution:**

We will first find the angle between the magnetic field vector at the origin and the +\( y \) axis. As explained in the video, the components are:

\[
B_y = \frac{\mu_0 I_2}{2\pi r}
\]
\[
B_x = \frac{\mu_0 I_1}{2\pi r}
\]

The angle between the vectors and the \( y \)-axis, using trigonometry, is:

\[
\theta = \tan^{-1}\left(\frac{B_x}{B_y}\right)
\]
\[
= \tan^{-1}\left(\frac{I_1}{I_2}\right)
\]
\[
= \tan^{-1}\left(\frac{30 \cdot 10^{-3}}{40 \cdot 10^{-3}}\right)
\]
\[
= 37^\circ
\]

We want the new field, when \( I_1 \) is increased, to be 20 degrees larger, or 57 degrees. This gives:
\[ 57 = \tan^{-1}\left(\frac{I_1}{40 \cdot 10^{-3}}\right) \]

Solving this we find that the necessary current is 62 mA.