

The PDSP16330 is designed to carry out the coordinate transform $x, y, z \rightarrow r, \theta, \phi$. Many applications in robotics and target positioning require three dimensional transformations of the form $x, y, z \rightarrow r, \theta, \phi$. This application brief shows how the Pythagoras Processor PDSP16330 can be used for three dimensional transforms.

Fig.1 shows a point x, y, z in a three dimensional space. If we move down the z -axis to the point $x, y, 0$, we are at a point whose distance from the origin is $h = \sqrt{x^2 + y^2}$ whose bearing is $\arctan(y/x)$. The distance from the origin to the point x, y, z is therefore given by $r = \sqrt{h^2 + z^2}$ and the elevation of that point given by $\arctan(z/h)$. In this way the three dimensional transform $x, y, z \rightarrow r, \theta, \phi$ has been decomposed into two 2- dimensional transforms which can be carried out by the Pythagoras Processor.

Fig.2 shows the most obvious implementation of a 3-D transform, using two Pythagoras Processors. The first processor is given x, y as its input, providing the bearing and the distance to the point $x, y, 0$. The second processor has z (suitably delayed to match the pipeline delay through the first processor) and h as its inputs giving r and ϕ as its outputs. Output θ from the first processor is delayed so that all three outputs suffer the same pipeline delay.

Fig.3 shows an alternative realisation employing a single Pythagoras Processor. In this case x and y data are input on every other cycle, the alternate cycle inputs being z and h . The z input has a pipeline delay to compensate for the delay on h relative to x and y . The configuration will achieve a throughput of 5MHz, half of the previous circuit.

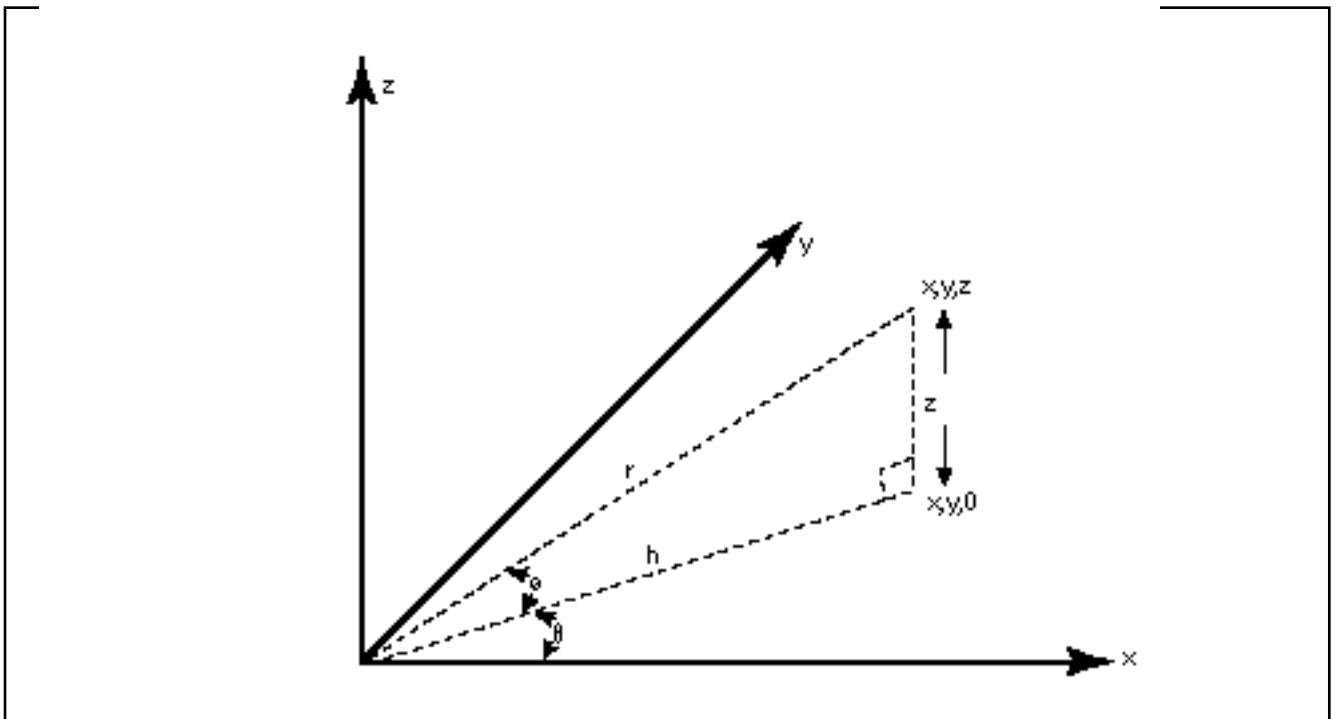


Fig.1

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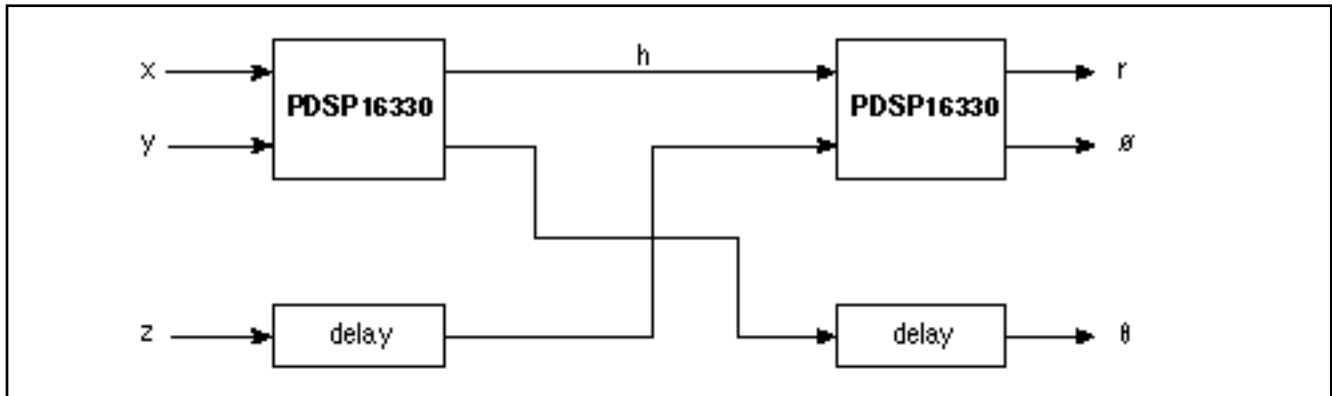


Fig.2

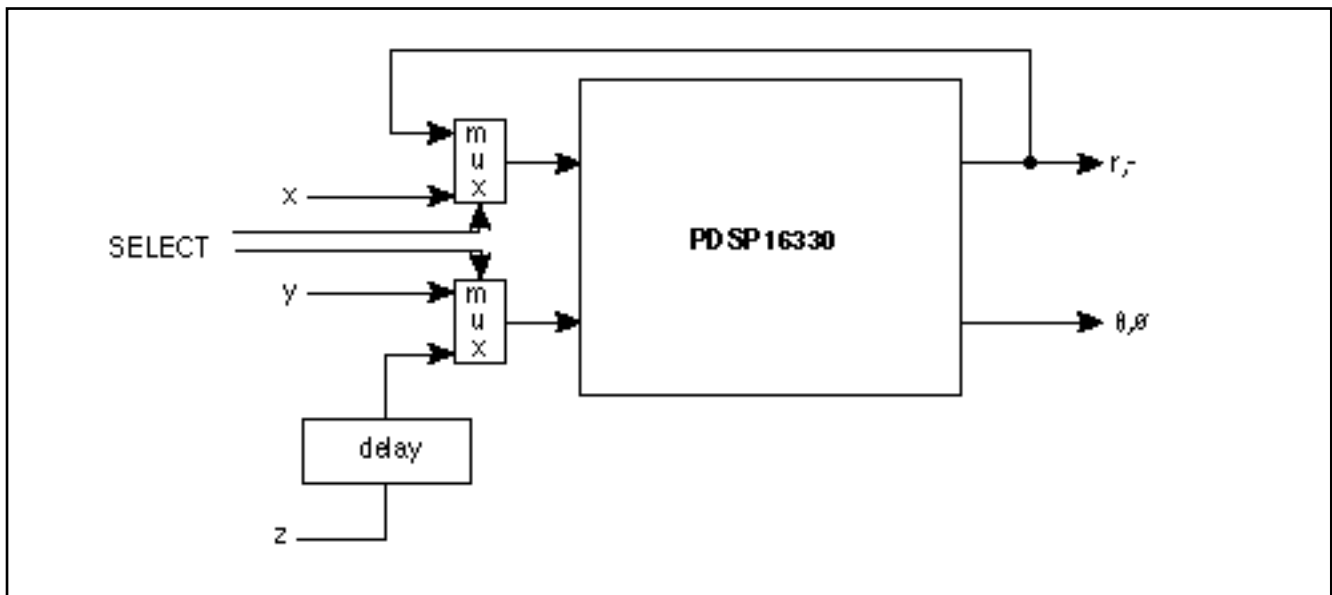


Fig.3



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© Mitel Corporation 1998 Publication No. AB17 Issue No. 2.1 July 1993

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