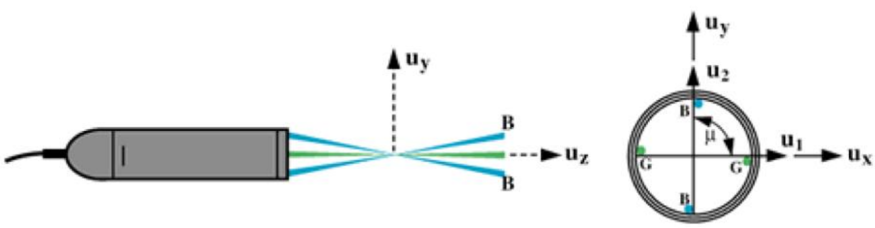
CORRECTING FOR NON-ORTHOGONAL MEASUREMENTS

LDV SYSTEMS

A two component fiberoptic probe system uses four beams to measure the two components of velocity in a plane normal to the axis of the probe. In most cases, the green and blue pair of beams are used to measure the velocity components.

It is possible that the angle between the two optical axes (μ) may not be exactly 90 degrees. In such a case, the velocity values measured by the probe will give two components of velocity that are not truly orthogonal to each other. Let the components of velocity measured (given by the lines joining the same color beams) by the probe be u_1 and u_2. From these measurements, the true orthogonal components of velocity u_x and u_y need to be obtained.

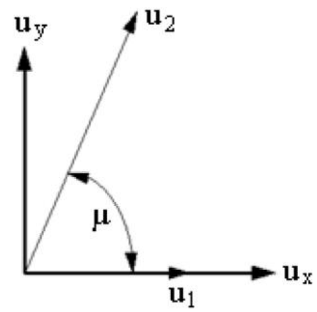


The amount of non-orthogonality *a* (*a* = 90 - μ) could be positive or negative, but generally would be small. The orthogonal components of velocity u_x and u_y could be written in terms of u_1 and u_2 as

$$u_x = u_1$$

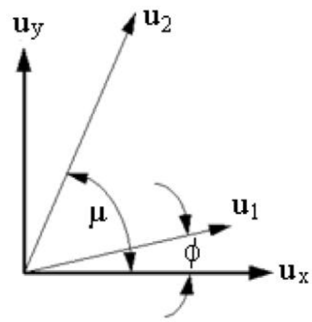
$$u_y = -u_1 (\tan a) + (1/\cos a)\, u_2$$

These conversions of velocities from non-orthogonal to orthogonal coordinate system can be done using FIND-W package. Under the MATRIX tab in the software screen, the matrix formulation for conversion could be used. For the case described above, the values of the matrix coefficients are:



A11 = 1.0	A12 = 0	A13 = 0
A21 = - tan *a*	A23 = 1/cos *a*	A23 = 0
A31 = 0	A32 = 0	A33 = 0

For the more general case, where the x-axis is not along the u_1 velocity direction the values of the orthogonal components of velocity u_x, u_y could be written in the matrix formulation as follows.



$$\begin{bmatrix} u_x \\ u_y \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

For this case, the values of the matrix coefficients are:

A11 = cos *a* / cos (*a* + Ø)	A12 = - sin Ø /cos(*a* + Ø)	A13 = 0
A21 = -sin *a* / cos(*a* + Ø)	A23 = cos Ø / cos(*a* + Ø)	A23 = 0
A31 = 0	A32 = 0	A33 = 0

Note: FIND-W also provides real-time displays (histograms, time histories) of the orthogonal components of velocities.