
NAME: ________________________________

Aircraft Guidance in a Crosswind

Statement of Problem: An aircraft flying under the guidance of a nondirectional beacon (NDB), which is a fixed radio transmitter, moves so that its longitudinal axis always points in the direction of the beacon. Initially the aircraft is heading towards the beacon with constant velocity or airspeed $v$ from a position with the wind at right angles to this initial direction. The wind does not change directions and its velocity is a constant $w$.

1. We are interested in the path of the aircraft over the ground, ignoring altitude, i.e. 2-dimensional formulation. In the $xy$-plane, assume that the beacon is located at the origin and the initial position of the aircraft is $(2,0)$. The wind is blowing in the positive $y$ direction. Derive a differential equation describing the aircraft’s path over the ground. The path of the aircraft is described by parametric equations $x(t)$ and $y(t)$. You need to derive equations for the dynamics of the path that satisfy ODE’s involving $dx/dt$ and $dy/dt$. The variable $t$ should not appear in your ODE’s so you can find an ODE for the parametric curve $y(x)$, i.e. an ODE with $dy/dx$. It is useful introduce $c = w/v$ into the equations.

2. Set up a Maple Worksheet to solve your ODE for the parametric curve $y(x)$. The first set of commands in your worksheet must be:

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restart; with(StringTools):FormatTime("%D-%T");with(DEtools):
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3. Use the unapply command to convert the solution of the ODE into a function. You might define your function to have two independent variables, $x$ and $c$.

4. Make plots on the same graph of the path of the aircraft for $c = 0, 0.2, 0.5, 1.0,$ and $1.2$. Please add a title and axes labels.

5. Discuss the cases $c = 1.0$ and $1.2$.

Comments: Please be sure to type your name at the top of the worksheet. You discussion for part 5 should be typed within the worksheet. You should not have to write anything by hand. Finally, before you print please print preview and try to minimize the amount of paper by shrinking any figures a bit.

*This project is based on material in the ODE text by Nagle and Saff that was attributed to T.L. Pearson, Acadia University