1\_VaAlphaBeta\_bodyframe/

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| **Case Folder/CASE No.** | **Common Parameter** | **Case Conditions** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_01** | **vtol.u0 = 0.000000001** | Base code is the test-case “..\e\_version\3\_kin\_dyn\**testcases4\_with\_euler\_limits\_u0=0\_theta\_singularity\_handled**”.  **Case specific code**  Va = sqrt(u\_r^2+v\_r^2+w\_r^2);  alpha = atan2(w\_r, u\_r);  beta = asin(v\_r/Va);  **vtol\_parameters.m**  vtol.pn0 = 0; % initial North position  vtol.pe0 = 0; % initial East position  vtol.pd0 = 0; % initial Down position (negative altitude)  **vtol.u0 = 0.000000001;** % initial velocity along body x-axis  vtol.v0 = 0; % initial velocity along body y-axis  vtol.w0 = 0; % initial velocity along body z-axis  vtol.phi0 = 0; % initial roll angle  vtol.theta0 = 0; % initial pitch angle  vtol.psi0 = 0; % initial yaw angle  e = Euler2Quaternion(vtol.phi0,vtol.theta0,vtol.psi0);  vtol.e0 = e(1); % initial quaternion  vtol.e1 = e(2);  vtol.e2 = e(3);  vtol.e3 = e(4);  vtol.p0 = 0; % initial body frame roll rate  vtol.q0 = 0; % initial body frame pitch rate  vtol.r0 = 0; % initial body frame yaw rate  **Wind gust: all zeros**    **wind\_parameters.m**  Doesn’t matter as wind parameters are all made zero  **Actuator deflections and throttle**: all zeros |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_02** | **vtol.u0 = 0.000000001** | * **Delta\_a = 2 deg** * Rest all parameters same as **case\_01** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_03** | **vtol.u0 = 0.000000001** | * **Delta\_e = 5 deg** * Rest all parameters same as case\_01 |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_04** | **vtol.u0 = 0.000000001** | * **Delta\_r = 4 deg** * Rest all parameters same as case\_01 |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_05** | **vtol.u0 = 0.000000001** | * **Delta\_t = 1.0** * Rest all parameters same as case\_01 |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_06** | **vtol.u0 = 30** | vtol\_parameters.m  **vtol.u0 = 30;** % initial velocity along body x-axis   * Rest all parameters same as case\_01 (all actuator deflections and throttle = 0) |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_07** | **vtol.u0 = 30** | * **Delta\_a = 2 deg** * Rest all parameters same as **case\_06** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_08** | **vtol.u0 = 30** | * **Delta\_e = 5 deg** * Rest all parameters same as **case\_06** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_09** | **vtol.u0 = 30** | * **Delta\_r = 4 deg** * Rest all parameters same as **case\_06** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_10** | **vtol.u0 = 30** | * **Delta\_t = 1.0** * Rest all parameters same as **case\_06** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_11** | **vtol.u0 = 10** | vtol\_parameters.m  **vtol.u0 = 10;** % initial velocity along body x-axis   * Rest all parameters same as case\_01 (all actuator deflections and throttle = 0) |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_12** | **vtol.u0 = 10** | * **Delta\_a = 2 deg** * Rest all parameters same as **case\_11** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_13** | **vtol.u0 = 10** | * **Delta\_e = 5 deg** * Rest all parameters same as **case\_11** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_14** | **vtol.u0 = 10** | * **Delta\_r = 4 deg** * Rest all parameters same as **case\_11** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_15** | **vtol.u0 = 10** | * **Delta\_t = 1.0** * Rest all parameters same as **case\_11** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_16** | Steady wind + Wind gust  WIND.Va0 = 25; | **wind\_parameters.m**  % wind parameters  WIND.wind\_n = 3;  WIND.wind\_e = 2;  WIND.wind\_d = 0;  WIND.L\_u = 200;  WIND.L\_v = 200;  WIND.L\_w = 50;  WIND.sigma\_u = 1.06;  WIND.sigma\_v = 1.06;  WIND.sigma\_w = 0.7;  WIND.Va0 = 25;  **Wind gust:**     * Rest all parameters same as **case\_11** (all actuator deflections and throttle = 0) |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_17** | Steady wind + Wind gust  WIND.Va0 = 25; | * **Delta\_a = 2 deg** * Rest all parameters same as **case\_16** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_18** | Steady wind + Wind gust  WIND.Va0 = 25; | * **Delta\_e = 5 deg** * Rest all parameters same as **case\_16** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_19** | Steady wind + Wind gust  WIND.Va0 = 25; | * **Delta\_r = 4 deg** * Rest all parameters same as **case\_16** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_20** | Steady wind + Wind gust  WIND.Va0 = 25; | * **Delta\_t = 1.0** * Rest all parameters same as **case\_16** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_21** | Steady wind + Wind gust  WIND.Va0 = 10; | wind\_parameters.m  **WIND.Va0 = 10;**   * Rest all parameters same as **case\_16** (all actuator deflections and throttle = 0) |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_22** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_a = 2 deg** * Rest all parameters same as **case\_21** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_23** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_e = 5 deg** * Rest all parameters same as **case\_21** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_24** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_r = 4 deg** * Rest all parameters same as **case\_21** |
| 1\_VaAlphaBeta\_bodyframe/  **Case\_25** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_t = 1.0** * Rest all parameters same as **case\_21** |

2\_VaAlphaBeta\_inertialframe/

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| **Case Folder/CASE No.** | **Common Parameter** | **Case Conditions** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_1** | **vtol.u0 = 10** | * Steady wind + wind gusts = all are zero. * Same conditions as in ‘1\_VaAlphaBeta\_bodyframe/ **Case\_11’** except that **Va, alpha, beta** output by forces\_moments.m was in body frame in ‘1\_VaAlphaBeta\_bodyframe/ **Case\_11’** whereas in ‘2\_VaAlphaBeta\_inertialframe/**CASE\_1’**,they are converted to inertial frame. * However, note that for forces and moment calculations in that file, **Va, alpha, beta** used are still in body frame because those equations assume they are in body frame. Just before output, **Va, alpha, beta** are converted to inertial. |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_2** | **vtol.u0 = 10** | * **Delta\_a = 2 deg** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**CASE\_1** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_3** | **vtol.u0 = 10** | * **Delta\_e = 5 deg** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**CASE\_1** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_4** | **vtol.u0 = 10** | * **Delta\_r = 4 deg** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**CASE\_1** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_5** | **vtol.u0 = 10** | * **Delta\_t = 1.0** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**CASE\_1** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_6** | Steady wind + Wind gust  WIND.Va0 = 10; | **wind\_parameters.m**  % wind parameters  WIND.wind\_n = 3;  WIND.wind\_e = 2;  WIND.wind\_d = 0;  WIND.L\_u = 200;  WIND.L\_v = 200;  WIND.L\_w = 50;  WIND.sigma\_u = 1.06;  WIND.sigma\_v = 1.06;  WIND.sigma\_w = 0.7;  **WIND.Va0 = 10;**  **Wind gust:**     * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**CASE\_1** * 2\_VaAlphaBeta\_inertialframe/Case 6 to 10 are best compared with 1\_VaAlphaBeta\_bodyframe/ Cases 21 to 25 to see the effect of converting Va, Alpha, Beta from body frame to inertial. |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_7** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_a = 2 deg** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**case\_6** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_8** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_e = 5 deg** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**case\_6** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_9** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_r = 4 deg** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**case\_6** |
| 2\_VaAlphaBeta\_inertialframe/  **CASE\_10** | Steady wind + Wind gust  WIND.Va0 = 10; | * **Delta\_t = 1.0** * Rest all parameters same as 2\_VaAlphaBeta\_inertialframe/**case\_6** |
| 3\_replacing Sfunction with own rk4 |  | * **Not only the Sfunction is replaced in this folder but also the code is converted to C-code and also compared.** |
| 3\_replacing Sfunction with own rk4/**CASE\_01** | * struct states **states\_in** = {0,0,0,0,0,0,0,0,0,0,0,0}; * struct force\_n\_moments **fm\_in** = {0,0,0, 0,0,0, 0,0,0, 0,0,0}; * struct actuators **delta** = {0,0,0,0}; * struct wnd \_**wind** = {0.0000000001,0.0000000001,0.0000000001,0.0000000001,0.0000000001,0.0000000001}; * int i; * float t = 0.0, t\_tot = 90.0; * float chi = 0.0; | * Giving completely zero in wind gives error in C-code. So keeping very low values in both C and Matlab for comparison. * All the actuator demands are zero. Note that fm\_in was just created here. These values are not used because they are calculated based on actuator deflection demands. * Result: C and M codes initially agree well but slowly fall apart. Have to fix this. |
| 3\_replacing Sfunction with own rk4/**CASE\_02** | * All same as 3\_replacing Sfunction with own rk4/**CASE\_01** except * In C: struct states **states\_in** = {0,0,0,**10**,0,0,0,0,0,0,0,0}; * In M:   vtol.pn0 = 0; % initial North position  vtol.pe0 = 0; % initial East position  vtol.pd0 = 0; % initial Down position (negative altitude)  vtol.u0 = **10**; % initial velocity along body x-axis  vtol.v0 = 0; % initial velocity along body y-axis  vtol.w0 = 0; % initial velocity along body z-axis  vtol.phi0 = 0; % initial roll angle  vtol.theta0 = 0; % initial pitch angle  vtol.psi0 = 0; % initial yaw angle  vtol.p0 = 0; % initial body frame roll rate  vtol.q0 = 0; % initial body frame pitch rate  vtol.r0 = 0; % initial body frame yaw rate |  |
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