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MEMO

To: Russell Larson

From: Walter Bernikowich

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Subject: SPEEDRUN Bias in Lateral Velocity

In my conversation today by telephone with Joe Cognozzi (GAEC), he described a simulation they performed in which a switch to ATTITUDE HOLD was made while in P66 and forward and lateral velocities nulled out as observed on the X-Pointer display. Switching back to AUTO a roll of about 7 degrees was experienced. He feels that this transient was due to 2 or 3 feet per second of lateral velocity at the time of switch back to AUTO. He pointed out that no data is available as to the magnitude of values that were being pulsed to the X-pointer display at this time by the Landing Analog Displays (R10) routine. However, their environment indicates, he says, 2.8 ft/sec. lateral velocity and DSKY Noun 60 displayed 0.6 ft/sec. forward velocity. Also he said that there are no errors in the computation by R10 of forward and lateral velocities that they were able to determine. With this background the question was:

What may contribute to the alleged discrepancy in lateral velocity as observed on the X-pointer display?

I responded by saying that a "worst case" combination of three major factors may produce a discrepancy in lateral velocity of up to 2 feet persecond; in forward velocity of up to 1 ft/sec. These are:

1. Granularity restriction (0.5571 ft/sec/bit). In converting from computed velocity values to bits at least 1/2 ft/sec. in accuracy may be lost.

2. Single precision computations. Due to TLOSS and lost downrupts problem, time available for calculations and storage capacity became important ingredients in the decision to code R10 in single precision and almost entirely in the AGC basic language. Velocities are computed and displayed during landing four times per second. In certain calculations of velocity relative to the moon a transition is performed in the program from double precision values to single precision.

3. Several parameters are computed elsewhere outside of R10 (e.g. sin AOG, cos AOG in GPMATRIX, GDT/2 in SERVICER) before the SPEEDRUN section of R10 grabs them for its own use in computing the lateral and forward velocities.

The precision of hardware (X-pointer) could also possibly add to the discrepancy. Eye-balling the needles may not produce exact, fine resolution.