Ballistic entry into circular orbit?

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Hello all.

Would someone please help me figure out the correct way to analyze a problem? Namely, is it possible to literally shoot something into circular orbit?

Assuming a vacuum, basic orbital mechanics says the orbit intersects the gun's location.

Posit an objectl in a highly elliptical orbit about a point−like Earth mass, perigee at the gun 4,000 miles out. To circularize the orbit at 4,300 miles, we have to a) reduce the apogee from God knows what to 4,300 miles and b) increase the perigee from 4,000 miles to 4,300 miles. Can we do that?

One way to increase an orbit's perigee is to add energy, but you have to do so when the satellite is at apogee. Obviously, you can't do that by introducing atmospheric drag into the model because you'd be subtracting energy, not adding it. Worse, the atmosphere is at the wrong end of the orbit. On the other hand, I don't know if that's the only way to increase an orbit's perigee.

By the same token, you can remove energy when the satellite is at perigee to reduce its apogee. That you can certainly do with atmospheric drag. Unfortunately, while that'll pull the apogee down, you're still stuck with a perigee at the gun. Again, I don't know if that's the only way to futz with the apogee.

For example, what happens if you add or subtract energy at a point in the orbit somewhere between apogee and perigee? Can you thereby take some apogee altitude and trade it for some perigee altitude?

One thing I know for sure: any object 300 miles up will be in circular orbit as long as is has 25,000 fps tangential velocity, zero radial velocity, and is under no accelerations other than gravity.

The sixty−four million dollar question is: given a real launch angle and velocity, can you employ real atmospheric drag to make a ballistic projectile launched from the surface achieve that state?

My first thought was to divide the muzzle velocity into radial and tangential components − or vertical and horizontal, near enough.

Use drag and sqrt(2gh) to figure the vertical component of the muzzle velocity needed to get the thing to 300 miles.

Use drag and surface velocity at your latitude to figure the horizontal component needed to produce a 25,000 fps surplus after passing though the atmosphere.

Muzzle velocity is then the root of the sum of the squares of the component velocities.

Aim point altitude is the arctangent of the ratio of the component velocities, vertical to horizontal.

Given strong enough materials, couldn't you thus put a projectile into just about any dynamic state you wanted to?

BUT

Orbital mechanics says