Meeting: 1003, Atlanta, Georgia, MAA CP J1, MAA Session on Projects and Demonstrations that Enhance a Differential Equations Course

1003-J1-168 **Andrew J Simoson*** (ajsimoso@king.edu), King College, 1350 King College Road, Bristol, TN 37620. *Sliding along a Chord through a Rotating Earth.*

Connect any two cities A and B on Earth's surface by a straight-line rail. If a train, powered only by Earth's gravity and Earth's rotation, runs along this track without resistance, how long will it take the train to go from A to B? Assume that the Earth's gravity is proportional to distance from the Earth's center, that $g = 9.8$ m/s^2, that the Earth is a sphere of radius $r = 6400$ km. Here are some train rides along various chords:

- Chords parallel to the z-axis: Simple harmonic motion with period of $\frac{2\pi}{\sqrt{k}}$ where $k = \frac{g}{R}$. This value is the same result as occurs for the nonrotating Earth along any chord—84.6 minutes.
- Chords in the x-y plane: Simple harmonic motion with period of about 9 seconds longer than in case above.
- Chords from the South Pole to the Equator: Choose Entebbe, Uganda, as a point on the Equator. Leaving Entebbe from rest our polar express turns back about 15.7 km shy of the South Pole. Leaving the South Pole from rest, the train slides on past the terminal at Entebbe and launches itself as a projectile, crash-landing about 22 km north.

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