Is “Hidden Figures” Related with Mathmatics?

The Hidden Figures tells the powerful based on true story of a group of female African-American mathematicians who worked on the first US space programme. The movie gives a shout-out to Euler’s Method a centuries-old math technique.

In my opinion the role played of the Katherine Johnson, a mathematician who was of NASA’s human “Computers” and an unsung hero of the space agency’s. in this movie, the head of the programme, played by Kevin, calls for an expert in analytic geometry when it becomes apparent that his team are unable to calculate the trajectories needed for safe re-entry of the US space flights. Katherine studied how to use geometry for space travel, and she used to calculate by her own hands. She used those skills to check the computer calculations for John Glenn’s orbit the earth. She used them again to help determine the trajectory for the 1969 Apollo 11 flight to the moon. She figured out the paths for the spacecraft to orbit Earth. NASA used Katherine's math, and it worked! NASA sent astronauts into orbit around Earth.

During a pivotal scene, Johnson and a team of white, male engineers are staring at a blackboard, trying to solve equations for the trajectory of astronaut john Glenn’s space capsule.

What does this have to do with linear algebra? First of all we will see that characteristic polynomials of matrices are polynomials. We need to factor them in order to find the eigenvalues. We will also see that if we take a polynomial of differential operators, the factorization allows us to solve differential equations.

The blackboard of Al Harrison (played by Kevin Costner) features equations of conic sections like ellipses given in polar coordinates as

$r = \alpha/(1+\varepsilon \cos(\theta))$

The problem of finding the trajectories of a rocket is a problem in differential equations. One equation we can see

$ds/dt = vr$, $dvr/dt = v\theta 2/r\ g(R/r)$

An other describes the motion in spherical coordinates (unfortunately, not all formulas are well visible):

$dr/dt = v \sin(\gamma)$

$d\theta/dt = v \cos(\gamma) \cos(\psi)/(r \cos(\phi))$

$d\phi/dt = v \cos(\gamma) \sin(\psi)/r$

$dv/dt = (1/m) Fr - g \sin(\gamma)$

$v\, d\gamma/dt = (1/m) Fm \cos(\gamma) - g \cos(\gamma) + (v2/r) \cos(\gamma)$

$v\, d\psi/dt = (1/m) F\ldots \sin(\gamma) + (v2/2)$

They are nonlinear but we will cover some nonlinear equations also in our course. Still, the Kepler problem can actually (with some clever transformation) be reduced to a Harmonic oscillator, which is a linear ODE. We see Catherine also work on some differential equations on the large blackboard.

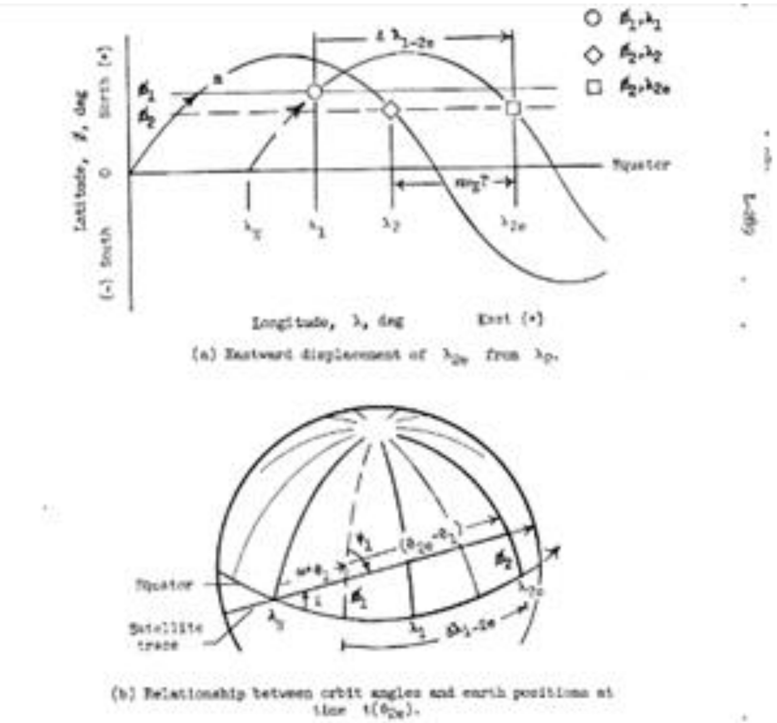

Figure 3.- Relation between selected position and equivalent position.