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MCT example

1) What is the minimum number of parameters to estimate the orbital state of a real spacecraft?

   a) 1
   b) 3
   c) 6
   d) It depends on the spacecraft

2) Given *m* observables and *n* state parameters, with $m > n$, the information matrix is:

   a) A *m* by *m* symmetric matrix
   b) A *n* by *n* symmetric matrix
   c) A *(m-n)* by *(m-n)* matrix
   d) A *m* by *n* rectangular matrix

3) In order to obtain a least squares orbital solution, the state transition matrix is essential to:

   a) Propagate the initial state to a future time
   b) Propagate the covariance matrix to the next observable
   c) Refer the observations to the same epoch
   d) Obtain the design matrix H

4) The orbit determination problem is an iterative process because:

   a) The precision in the solution improves at every iteration
   b) The solution must be unbiased
   c) The dynamical models is non-linear
   d) The dynamical and observation models are both non-linear

5) When the residuals show signatures even after a large number of iterations, then:

   a) The observation model is incorrect
   b) The dynamical model is inadequate
   c) The data may be biased or affected by systematic noise
   d) Any of the above cases may happen

6) The Kalman filter estimator is:

   a) Linear of the new data
   b) Non-linear in the a priori state
   c) A batch, minimum variance estimator
   d) Rarely used in real time estimation problems

7) Solving the Wahba's problem provides:

   a) The angles between the stars and the spacecraft
   b) The attitude matrix of the spacecraft
   c) The spacecraft position with respect to a planetary body
   d) The position of a few stars in the reference frame of the star tracker

8) A star tracker measures:

   a) The magnitude of a star
   b) The angular velocity of the spacecraft
   c) The angular positions of stars in the sensor reference frame
   d) The vector from the spacecraft to the star

9) Which system would you use to control the attitude of a spacecraft in the cruise phase from Earth to Jupiter?

   a) Star sensors and gyroscopes
   b) Reaction wheels
   c) Reaction wheels and thrusters
   d) Magnetic torqrods and thrusters

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10) In order to maintain one of the spacecraft's axes in a desired direction, a PID control is preferred over the PD control when:

a) A nearly constant external torque is expected
b) The satellite is three-axis stabilized
c) The gravity gradient is large
d) The satellite must reach the desired attitude very quickly

11) TAI and UTC differ

a) Because TAI is an atomic time scale, while UTC is astronomical time scale.
b) Because the reference epoch of the two scales are different
c) By a finite numbers of seconds, periodically adjusted
d) Because the TAI second is defined using a caesium frequency standard on the geoid, while UTC is a global time scale valid in the entire solar system

12) Which of these quantities is least affecting the SNR in a radio link to a deep space probe:

a) The pointing accuracy of the ground and space parabolic antennas
b) The elevation of the spacecraft
c) The noise temperature of the receiver
d) The frequency stability of the oscillator (H-maser, caesium) used in the generation of the signal

13) Range rate measurements from a digital phase locked loop

a) Require that the received signal does not drift in frequency
b) Require that the modulating subcarriers have been previously removed
c) In general require a large SNR (typically > 40 dBHz)
d) Are noisier if the time constant of the loop filter is small

14) The International Celestial Reference Frame (ICRF)

a) Is built out of the positions of planetary bodies, known from optical observations and tracking of space probes
b) It is an Earth-centred, Earth-fixed frame built from observation of extragalactic radio sources
c) It is an inertial reference frame built from precise relative angular measurements of extragalactic radio sources
d) It is an inertial reference frame built from precise angular observations of radio sources in our galaxy

15) The angular accuracy in a delta-DOR measurement

a) Is inversely proportional to the wavelength of the radio link
b) Is inversely proportional to the length of the baseline vector
c) Depends on the synchronisation between clocks at the two stations by means of GPS
d) Is independent from the angular separation between the reference quasar and the spacecraft.