• Arc-length Reparameterization
  – Adaptive Gaussian Quadrature for estimating arc length
  – Mapping from frame number to arc length to parameter value (i.e. computing $u(s(f))$).

• Interpolation
  – Interpolation vs. Approximation
  – Continuity
  – Global vs. Local Control
  – Hermite, Catmull-Rom, and B-splines

• Representing and Interpolating Orientations
  – Rotation Matrices
  – Fixed Angle
  – Euler Angle
  – Axis and Angle
  – Quaternion
  – Slerp
  – Qlerp

• Ease-in/Ease-out
  – Monotonic curves don’t go backwards in time
  – Continuity ensure there is not a jump
  – Sine interpolation
  – Using sineusoidal pieces for acceleration and deceleration
  – Cubic polynomial
  – Parabolic (constant acceleration)

• Paths
  – Frenet Frame
  – Camera path following (center of interest)
  – Smoothing paths

• Kinematic Chains and Inverse Kinematics
  – Kinematic hierarchies
  – Reduced Coordinates
- Forward kinematics (descending the hierarchy)
- Inverse kinematics
- Jacobian (what it is, how entries are computed)
- Pseudo-inverse, Jacobian transpose (gradient descent)
- Cyclic coordinate descent
- Adding secondary constraints in the null-space of the Jacobian

• Motion Capture
  - The motion capture process
  - Camer calibration
  - Actor calibration
  - T-pose, motorcycle pose, range of motion
  - Capturing 3D positions
  - Computing trajectories
  - Skeleton template
  - Skeleton Fitting
  - Editing motion capture data: Warping, retargeting, graphs

• Simulation and Optimization
  - Lagrangian mechanics
  - Featherstone dynamics
  - Control systems
  - Finite state machines
  - Control laws and goal joint angles
  - Proportional derivative controller
  - Constrained optimization
  - Energy functions (e.g. minimize joint torques)
  - The importance of contact