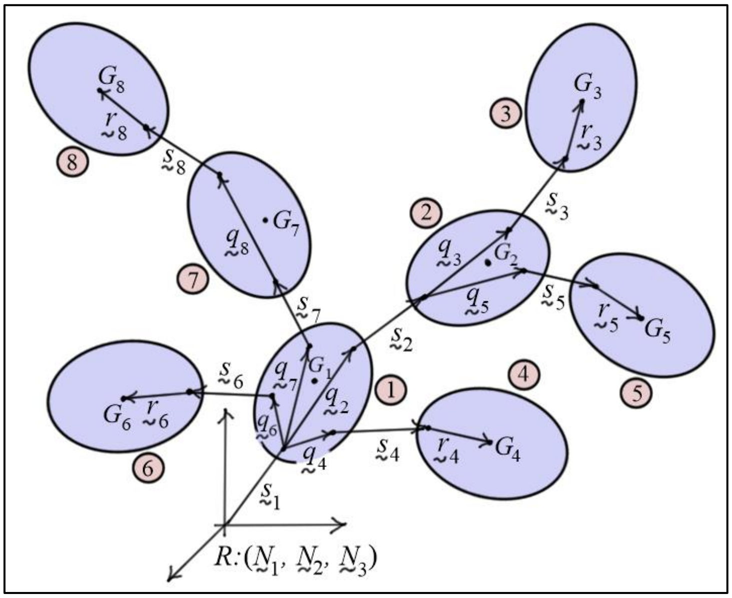
Multibody Dynamics
Exercises #2.1 (Continuation of Exercises #2)

Consider the multibody system shown in the diagram. As in Exercises #2, the orientations of the bodies are specified relative to the inertial frame R (***absolute angles***) using a 3-2-1 body-fixed rotation sequence. Also, the positions of the mass centers of all the bodies are to be specified using ***relative coordinates*** as indicated by the vectors in the diagram. Vectors $\underset{\sim}{s}_i$ $(i=1,\ldots,8)$ represent translation vectors for the bodies relative to their ***adjacent, lower-numbered*** body and are expressed in the lower-numbered body frame.



For example, since B_1 is the lower-numbered body of B_7,

$$\underset{\sim}{s}_7 = \sum_{i=1}^{3} x_{7i}\, \underset{\sim}{n}_{1i}$$

The vectors fixed in the bodies of the system are expressed in the reference frames of the bodies in which they are fixed. For example,

$$\underset{\sim}{q}_8 = \sum_{i=1}^{3} q_{8i}\, \underset{\sim}{n}_{7i}$$

Complete the following:

a) Find the inertial components of the position vector of G_3 the mass-center of body B_3. Express the results in matrix-vector form.

b) Find the inertial components of the velocity of G_3 the mass-center of body B_3. Express the results in matrix-vector form using the body-fixed angular velocity components. Then, identify the partial velocity matrices associated with $\dot{x}_{1i}$, $\dot{x}_{2i}$, $\dot{x}_{3i}$, $\dot{\theta}_{1i}$, $\dot{\theta}_{2i}$, and $\dot{\theta}_{3i}$.