Software

G-DYN Multibody Dynamics Engine

G-DYN is a multi-body dynamic simulation software engine that automatically assembles and integrates equations of motion for arbitrarily connected multi-body dynamic systems.

The algorithm behind G-DYN is based on a primal-dual formulation of the dynamics that captures the position and velocity vectors (primal variables) of each body and the interaction forces (dual variables) between bodies, which are particularly useful for control and estimation analysis and synthesis. It also takes full advantage of the sparse matrix structure resulting from the system dynamics to numerically integrate the equations of motion efficiently. Furthermore, the dynamic model for each body can easily be replaced without re-deriving the overall equations of motion, and the assembly of the equations of motion is done automatically.

G-DYN proved an essential software tool in the simulation of spacecraft systems used for small celestial body surface sampling, specifically in simulating touch-and-go (TAG) maneuvers of a robotic sampling system from a comet and asteroid. It is used extensively in validating mission concepts for small bodies, which are particularly useful for control and estimation analysis and synthesis. The state of that transmission during an additional round-trip time and/or frequent interruptions in connectivity. Communication in interplanetary space is the most prominent example of this sort of environment, and LTP is principally aimed at supporting "long-haul" reliable transmission over deep-space RF links.

Like any reliable transport service employing ARQ (Automatic Repeat Request), LTP is "stateful." In order to assure the reception of a block of data it has sent, LTP must retain for possible retransmission all portions of that block which might not have been received yet. In order to do so, it must keep track of which portions of the block are known to have been received so far, and which are not, together with any additional information needed for purposes of retransmitting part, or all, of the block. Long round-trip times mean substantial delay between the transmission of a block of data and the reception of an acknowledgement from the block’s destination, signaling arrival of the block. If LTP postponed transmission of additional blocks of data until it received acknowledgement of the arrival of all prior blocks, valuable opportunities to use what little deep space transmission bandwidth is available would be forever lost.

For this reason, LTP is based in part on a notion of massive state retention. Any future small-body mission will require resources for all of them. Moreover, the LTP engines must necessarily retransmit any data and the reception of an acknowledgement of the arrival of all prior blocks, valuable opportunities to use what little deep space transmission bandwidth is available would be forever lost.

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For this reason, LTP is based in part on a notion of massive state retention. Any number of requested transmission conversations (sessions) may be concurrently "in flight" at various displacements along the link between two LTP engines, and the LTP engines must necessarily retain transmission status and retransmission resources for all of them. Moreover, if any of the data of a given block are lost en route, it will be necessary to retain the state of that transmission during an addi-