PARTITIONING OF LARGE SPACE STRUCTURES

VIBRATION CONTROL COMPUTATIONS

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LQG SIZING

	BEAM	ANTENNA
SENSOR/ACTUATOR PAIRS (m)	6	36
CONTROL STATES (n_c)	20	20
FLOP PER CYCLE*	1420	4420
VARIABLES**	752	2312
I/O PER CYCLE	12	72

*INCLUDES SENSOR COMPENSATION FLOP (120 FOR BEAM, 720 FOR ANTENNA)
**INCLUDES SENSOR COMPENSATION VARIABLES (60 FOR BEAM, 360 FOR ANTENNA)

HAC/LAC SIZING

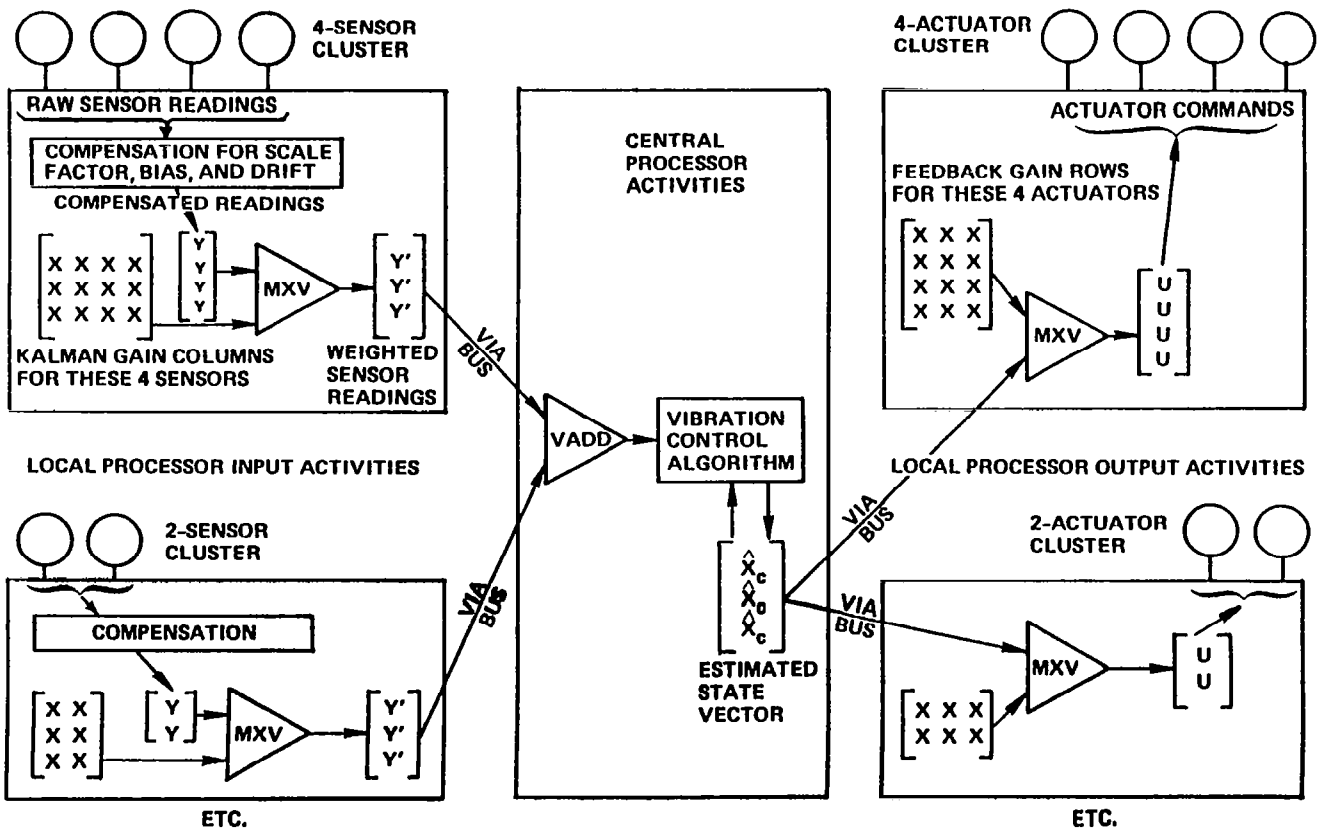
	BEAM	ANTENNA
SENSOR/ACTUATOR PAIRS (m)	6	36
CONTROL STATES (n_c)	12	12
FLOP PER CYCLE*	633	4608
VARIABLES**	570	3060
I/O	12	72

*INCLUDES SENSOR COMPENSATION FLOP (120 FOR BEAM, 720 FOR ANTENNA)
**INCLUDES SENSOR COMPENSATION VARIABLES (60 FOR BEAM, 360 FOR ANTENNA)

DISTRIBUTION OF VIBRATION CONTROL AND SENSOR COMPENSATION COMPUTATIONS

- A RANGE OF CHOICES BETWEEN THE TWO FOLLOWING EXTREMES WAS INVESTIGATED:
  - CENTRAL COMPUTATION OF BOTH CONTROL AND SENSOR COMPENSATION
  - CONTROL COMPUTATIONS DISTRIBUTED AMONG CENTRAL AND LOCAL PROCESSORS; LOCAL PROCESSORS ALSO PERFORM SENSOR COMPENSATION
    - PORTIONS OF THE CONTROL COMPUTATIONS CAN BE DISTRIBUTED BECAUSE THE ROWS OR COLUMNS OF THE MATRICES INVOLVED CORRESPOND TO INDIVIDUAL SENSORS OR ACTUATORS
      - DISTRIBUTION IS SUPPORTED BY THE FACT THAT THE MATRICES INVOLVED ARE EITHER CONSTANT OR INFREQUENTLY CHANGED

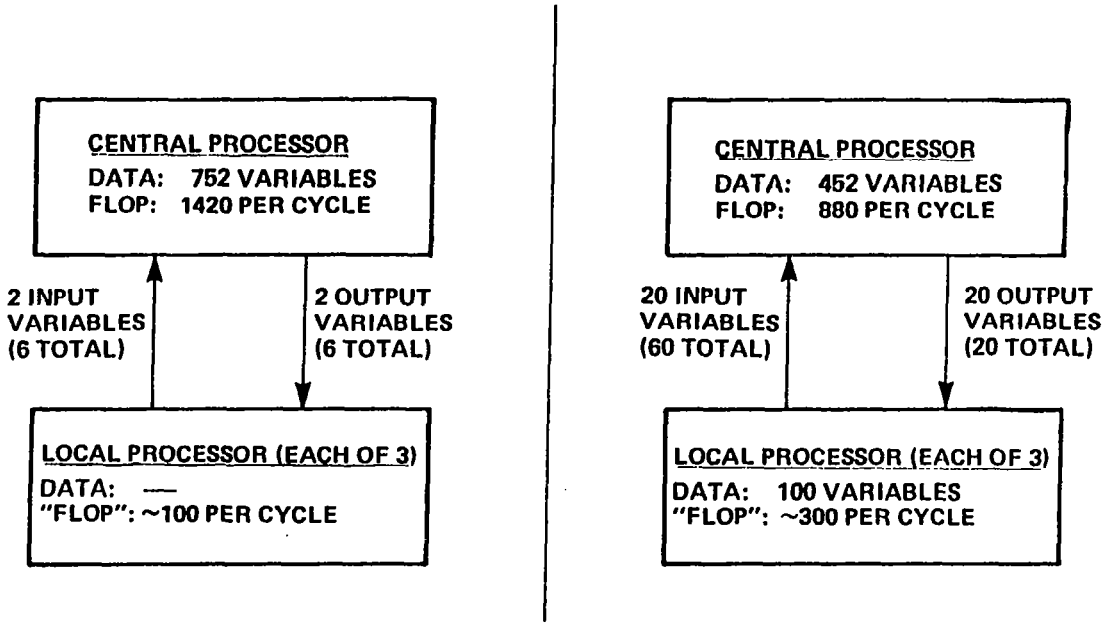
LSSC COMPUTATION DISTRIBUTED AMONG CENTRAL AND LOCAL PROCESSORS



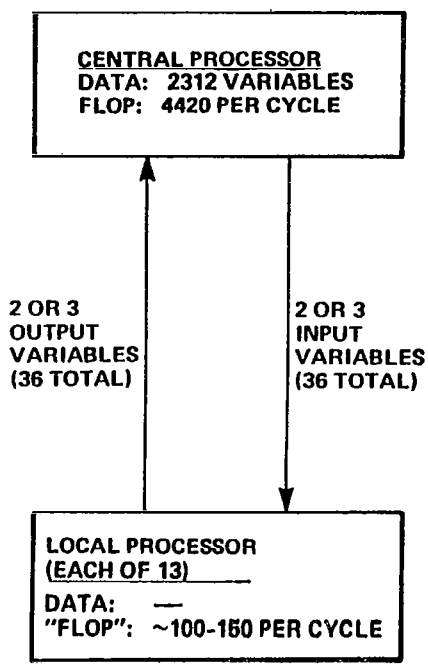
RECOMMENDATIONS FOR CENTRAL/LOCAL PROCESSOR PARTITIONING

- LQG COMPUTATIONS THAT SHOULD BE DISTRIBUTED TO LOCAL PROCESSORS, IN ORDER OF DECREASING PREFERENCE
  - COMPENSATING SENSOR READINGS FOR SCALE FACTOR, BIAS, AND DRIFT
  - APPLYING FEEDBACK GAIN TO ACTUATOR COMMANDS
  - APPLYING KALMAN GAIN TO COMPENSATED SENSOR READINGS
- HAC/LAC COMPUTATIONS THAT SHOULD BE DISTRIBUTED TO LOCAL PROCESSORS, IN ORDER OF DECREASING PREFERENCE
  - COMPENSATING SENSOR READINGS FOR SCALE FACTOR, BIAS, AND DRIFT
  - APPLYING LOW-AUTHORITY GAIN TO ACTUATOR COMMANDS
  - APPLYING HAC FEEDBACK & FILTER GAINS TO ACTUATOR COMMANDS
  - APPLYING KALMAN GAIN TO COMPENSATED SENSOR READINGS
- FREQUENCY SHAPING FILTER COMPUTATION (HAC/LAC) SHOULD STAY IN CENTRAL PROCESSOR

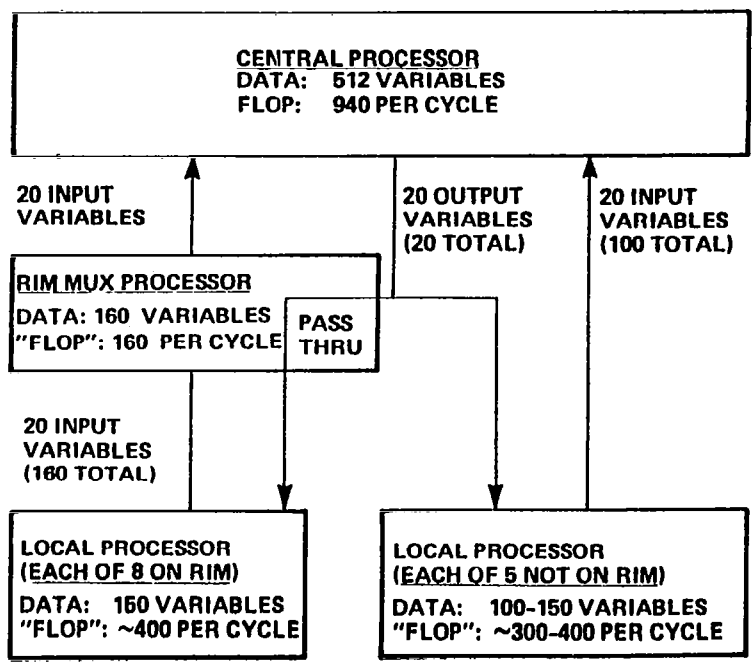
LQG ALGORITHM (n_c = 20) FOR BEAM



LOG ALGORITHM (n_c = 20) FOR ANTENNA

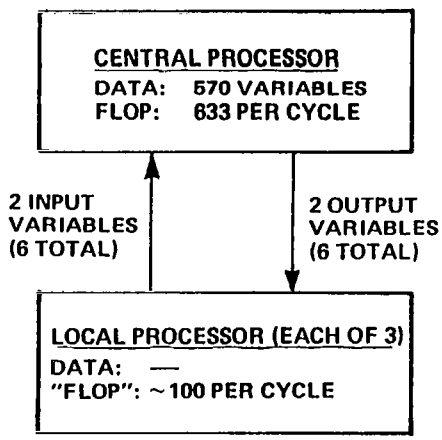


CENTRALIZED

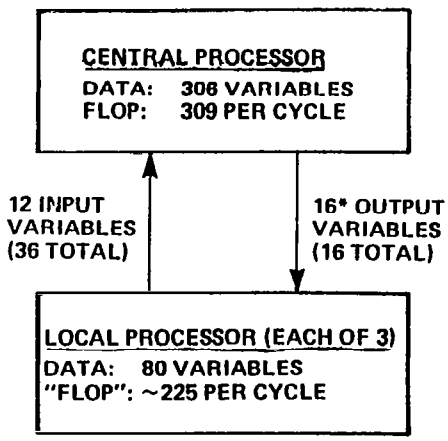


DISTRIBUTED

HAC/LAC ALGORITHM (n_c = 12) FOR BEAM



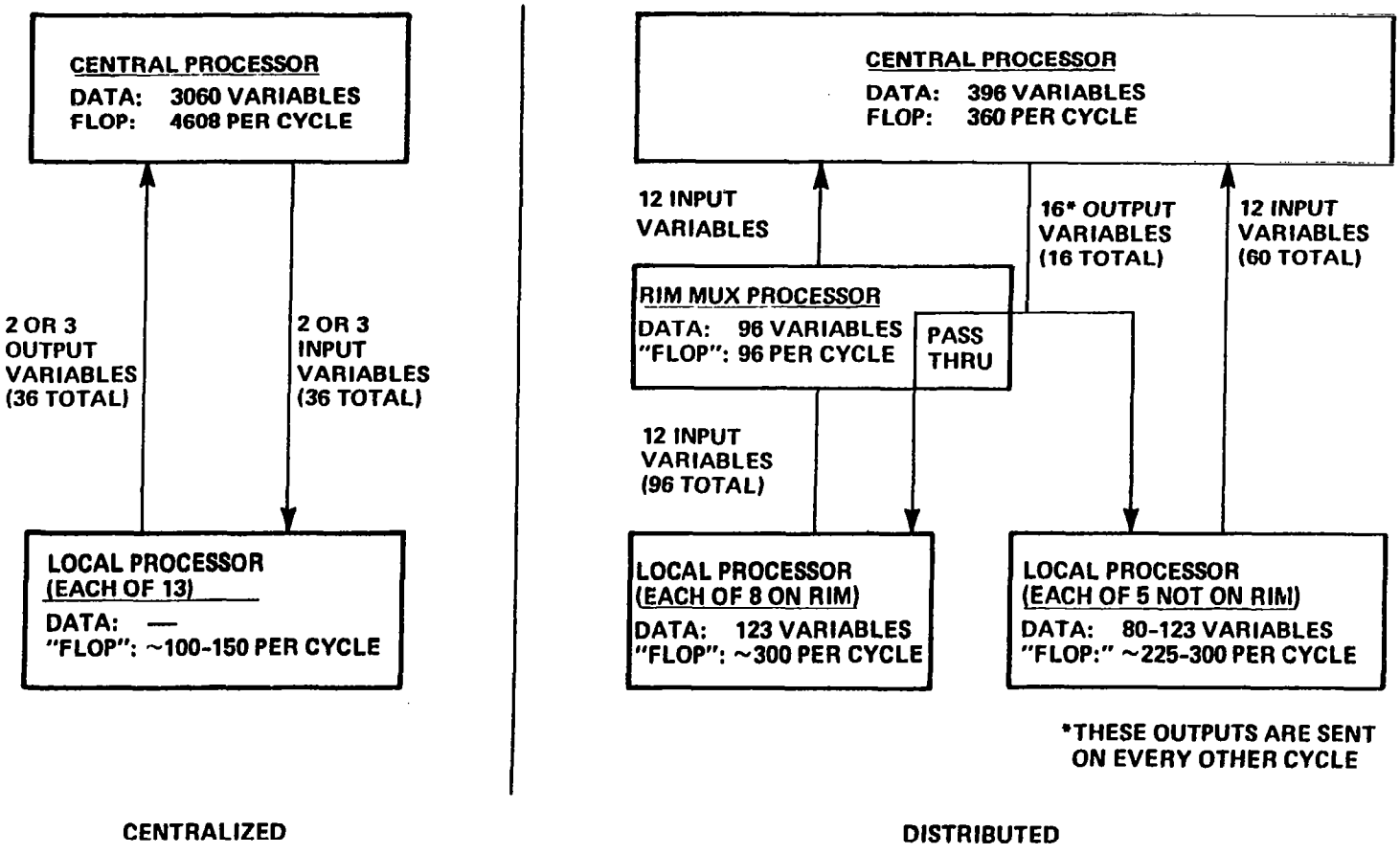
CENTRALIZED



*THESE OUTPUTS ARE SENT ON EVERY OTHER CYCLE

DISTRIBUTED

HAC/LAC ALGORITHM (n_c = 12) FOR ANTENNA



CONCLUSION

- VIBRATION CONTROL OF LARGE SPACE STRUCTURES IS COMPUTATIONALLY DEMANDING - DRIVEN BY
  - NUMBER OF VIBRATION MODES CONTROLLED
  - NUMBER OF SENSOR/ACTUATORS PAIRS
  - CONTROL BANDWIDTH

- DISTRIBUTION OF THE VIBRATION CONTROL COMPUTATIONS AMONG CENTRAL AND LOCAL PROCESSORS CAN SIGNIFICANTLY REDUCE THE THROUGHPUT REQUIRED FROM THE CENTRAL PROCESSOR AND MAY ALSO RESULT IN IMPROVED PERFORMANCE DUE TO REDUCED TRANSPORT LAG