SAFE SEPARATION

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INTRODUCTION

- External stores, which include weapons, fuel tanks, and other equipment, are often attached to aircraft to increase their operational capabilities. However, it is important to ensure that these stores can be safely separated from the aircraft when necessary, such as during an emergency or when the mission is complete.
- The external store separation process typically involves the activation of a release mechanism, which can vary depending on the type of store and aircraft. The release mechanism can be controlled manually by the pilot or automatically by the aircraft's onboard systems.
- Overall, the safe separation of external stores from an aircraft is a critical aspect of flight operations that requires careful planning and execution to ensure the safety of all personnel involved.

Bomb racks are aircraft equipment which suspends, carries, and releases ordnance from the military aircraft. A majority of bomb racks are installed semi-permanently on an aircraft, and are designated parent racks. Most bomb racks are categorized as either ejection racks or free-fall racks. A free-fall bomb rack releases the ordnance with the help of gravity from the rack when requirements for launch have been met, while an ejector-type bomb rack releases its payload by firing a cartridge-actuated device to ejects the ordnance.

High speed attack and fighter aircraft are capable of creating a vacuum condition under the aircraft body. This condition can mean that a free-fall ordnance does not fall toward the target, but may stay in contact with the aircraft, causing damage or the total loss of the vehicle. Ejector racks eject the store from the bomb racks with enough force to overcome the vacuum condition and to launch the weapon safely. These launchers are classified as either ejection- or rail-type launchers.

- **Ejection type launchers** use cartridge-generated gas pressure fired in the launcher breech to separate the weapon from the aircraft. The missile motor is then set off at a safe distance underneath the aircraft.
- **Rail-type launchers** are usually attached to the wing hard points. Rail-type launchers make it possible to activate the missile motor while the weapon is still connected to the store. After the motor fires, the thrust generated overpowers the weapon restraining device, and the missile is launched from the aircraft.
- **A tube-type launcher** is a variation of the rail-type launcher. Tube-type missile launchers hold missile in launch tubes until the missile motor is set off. The weapon then releases from the tube similar to the firing of aircraft-mounted rockets

carry arm, and release stores. racks are either part of, or can be inserted into, the modular bay of a support structure such as a pylon. a rack can mount a store or another piece of suspension equipment, for example, numerous bombs being mounted onto a single pylon, such as was done on f-105 Thunderchief missions over Vietnam, or the large external pylons on the b-52 Stratofortress, which can carry 12 unguided bombs in four triple ejector racks mounted to a single pylon. alternatively, using the same pylon, but different racks and adapters the store is mounted by locking the store's lugs with l-shaped suspension hooks in the rack. depending on the mass of the store there can be a single lug or a number of lugs on the store separated by a certain distance. a rack can release a store via gravity or by ejection. ejection utilizes an impulse cartridge, a pyrotechnic device which provides jettison capability by igniting and supplying an ejection force to safely propel a store away from the rack and aircraft. a multiple ejector rack (Mer) usually refers to a support structure which enables the carriage of six stores. a triple ejector rack (Ter) refers to a support structure which enables the carriage of three stores.

Station Designation

the Boeing f/a-18a/b/c/d family has nine weapons stations:

- 1 & 9, at the wingtips, have a single rail launcher for an aim-9 type store.
- 2, 3, 7, & 8, located under the left and right.
- 4 & 6, which are located on the sides of the fuselage.
- 5, which is on the centreline underneath the fuselage.
- 3, 5, & 7, are 'wet' feed fuel to and from external fuel tanks.

Jettison

this is a rapid and complete release of the external store from the aircraft. jettison is usually used in emergency situations to quickly reduce weight or eliminate a potential hazard..

Eject

This type of separation is used for stores that have their own propulsion system, such as missiles. The eject mechanism propels the store away from the aircraft and initiates its guidance system.

Store Release

This is a controlled release of the external store from the aircraft using a release mechanism, which can be manual or automatic. Store release can be used in both combat and non-combat situations.

Delayed Separation

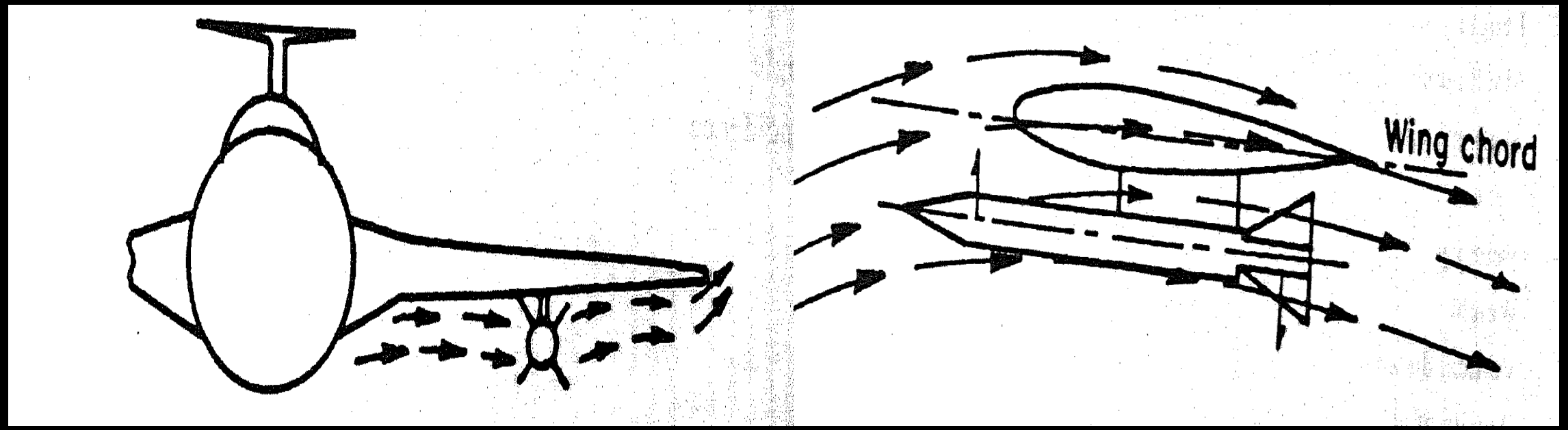
This is a type of store release that is timed to occur after a certain period of time or distance has elapsed.

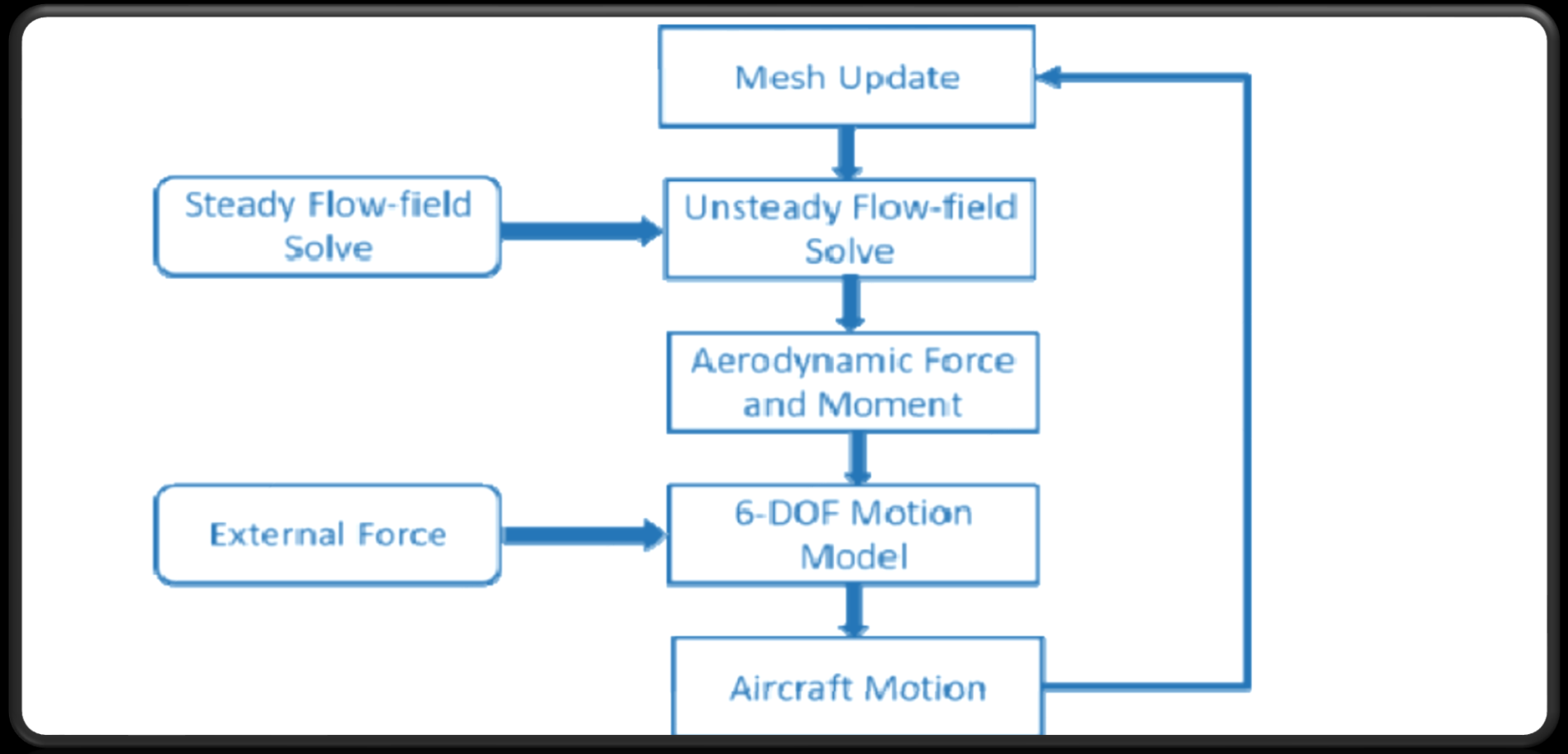
Sequential Separation

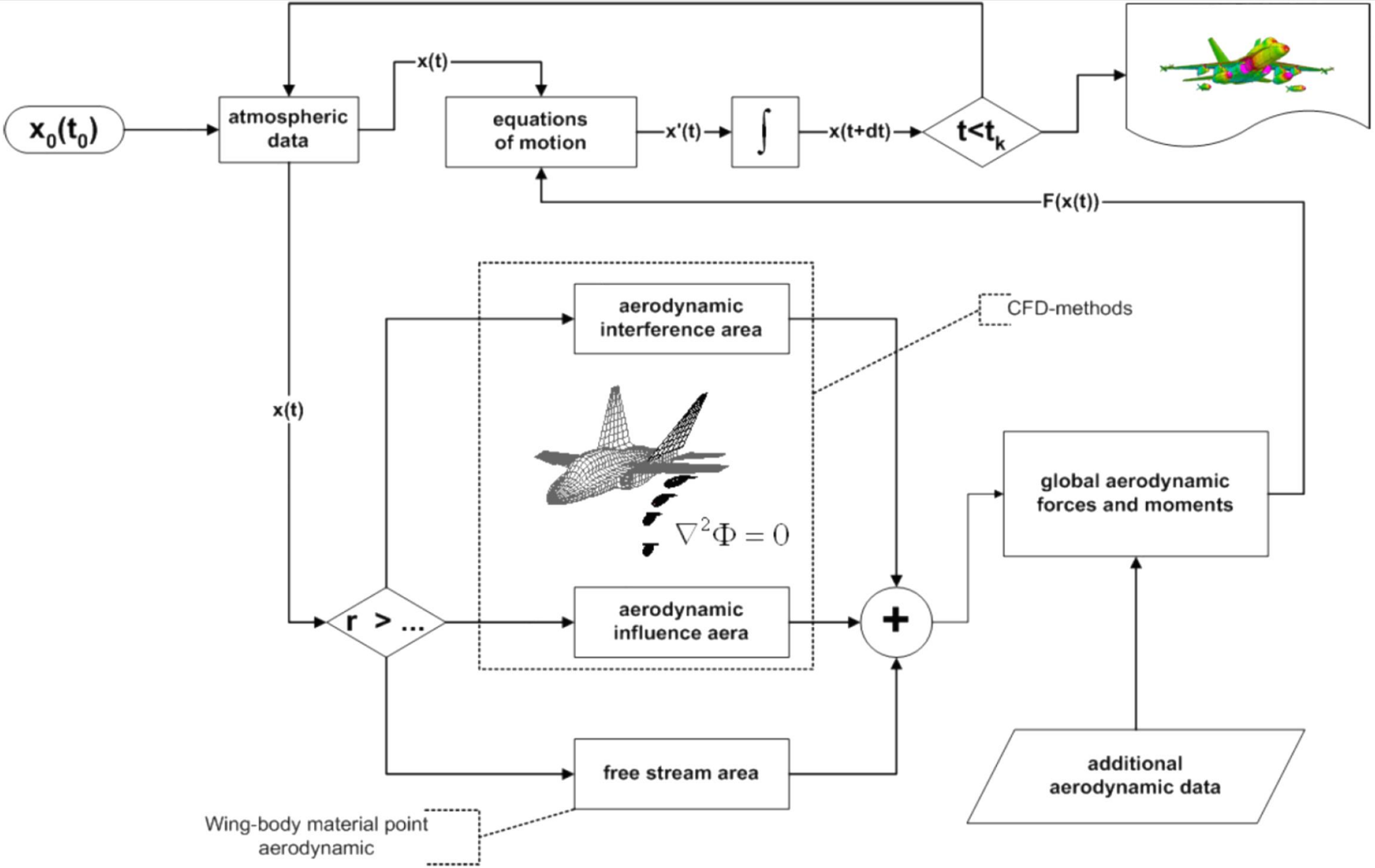
This involves the release of external stores in a specific sequence to maintain the balance and stability of the aircraft. Sequential separation is typically used for multiple external stores that are released during a single mission.

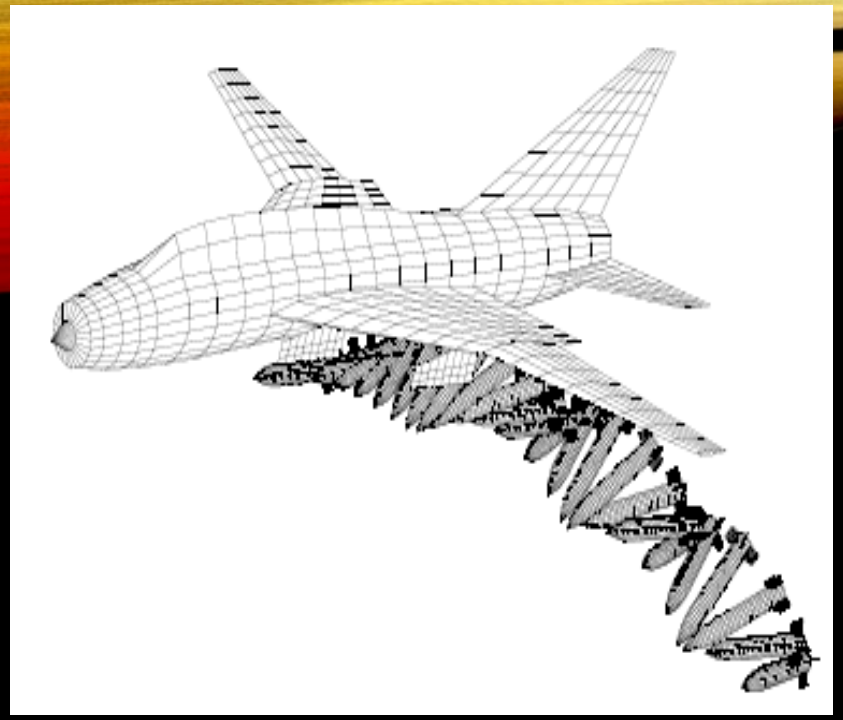
THEORETICAL ANALYSIS

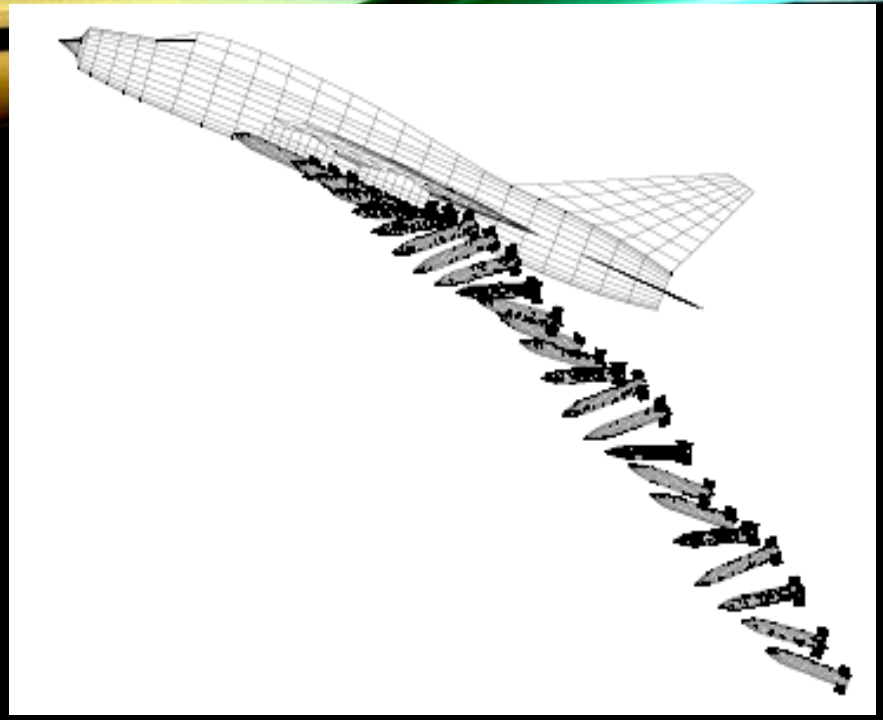
The aerodynamic problem of releasing the store from the parent aircraft needs individual attention to ensure safe. acceptable separation and minimum deviation from the intended flight path. the flow field of an aircraft store combination is complex and non-uniform having large variations in down wash, side wash and local dynamic pressure along both longitudinal and lateral directions. the flow field gets modified because of presence of the stores and their support devices. because of large changes in the flow field parameters and corresponding changes in the store loads and moments are also encountered. as a result, the store will exhibit erratic separation characteristics after release or ejection. the problem can be more severe at transonic or supersonic speeds because of the presence of shock waves and their interaction on the store flow field, increased dispersion and even in rare cases loss of the parent aircraft.

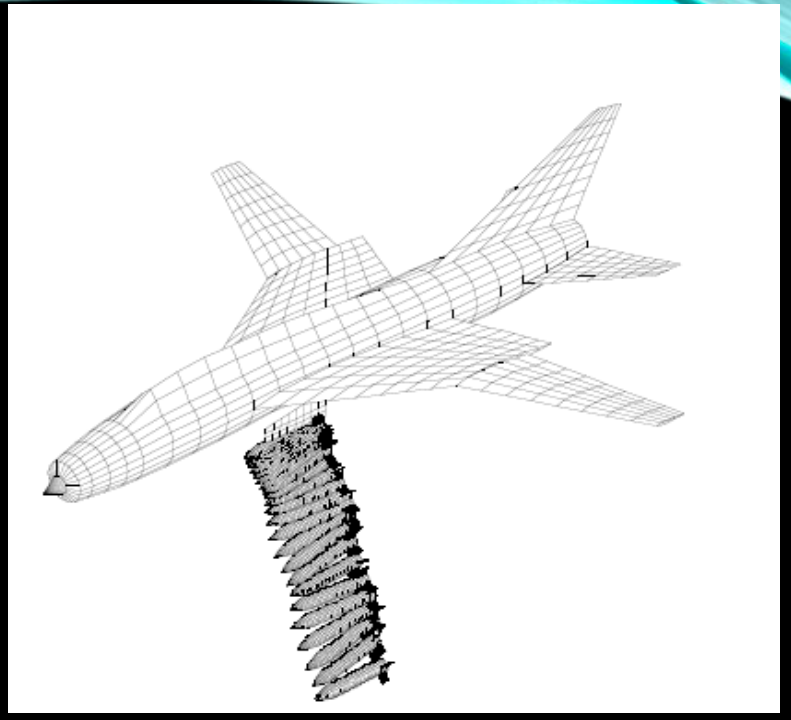


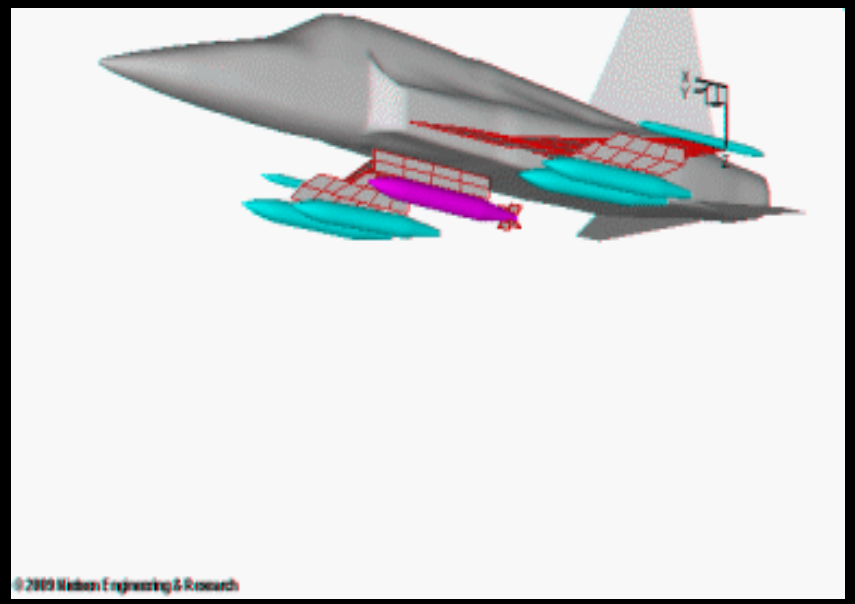

Mesh Update
Steady Flow-field Solve
Unsteady Flow-field Solve
Aerodynamic Force and Moment
External Force
6-DOF Motion Model
Aircraft Motion

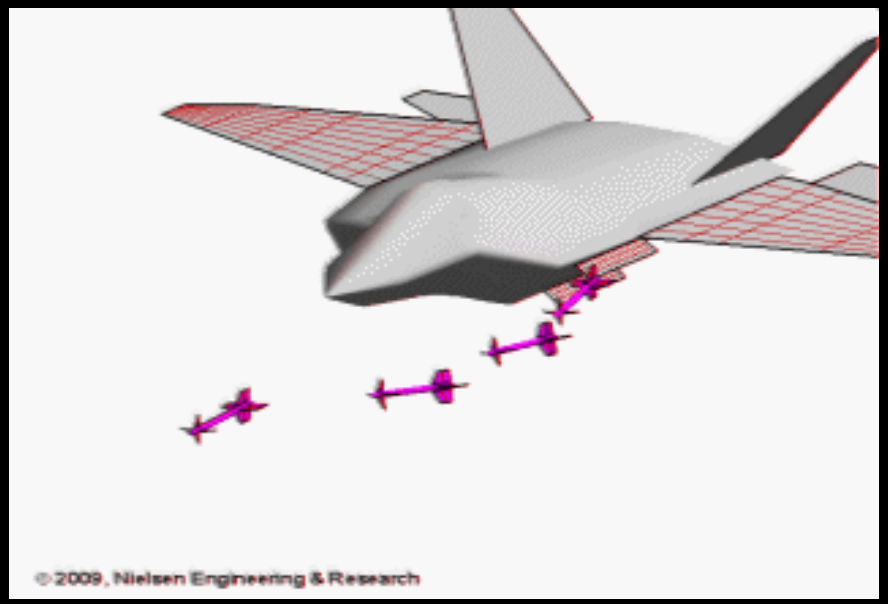

$x_0(t_0)$
atmospheric data
x(t)
equations of motion
x'(t)
∫
x(t+dt)
$t<t_k$
F(x(t))
x(t)
aerodynamic interference area
CFD-methods
$\nabla^2\Phi = 0$
r > ...
aerodynamic influence aera
+
global aerodynamic forces and moments
free stream area
additional aerodynamic data
Wing-body material point aerodynamic







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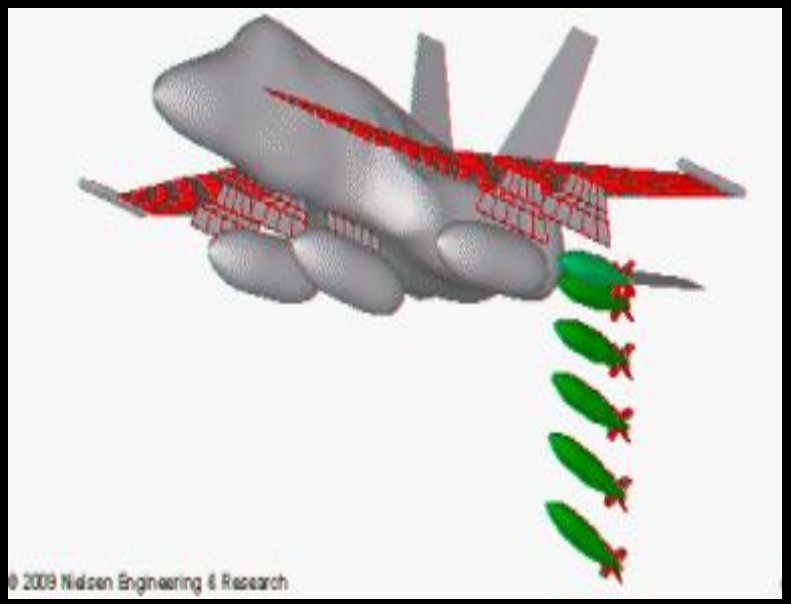
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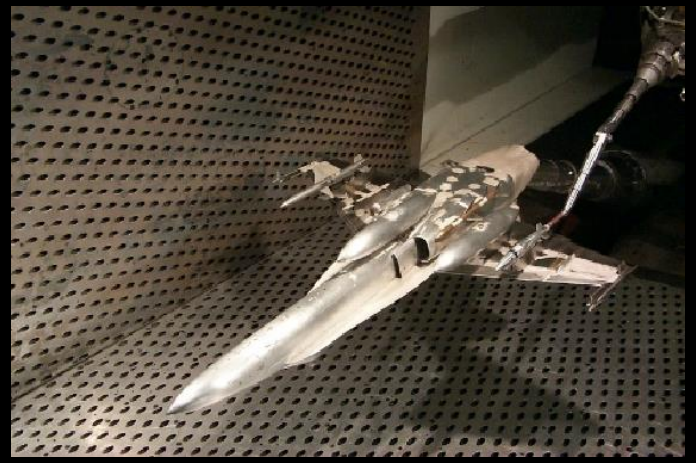
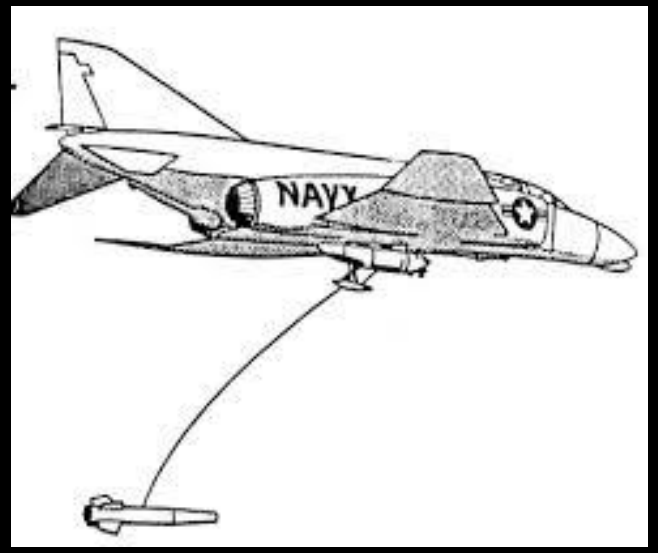
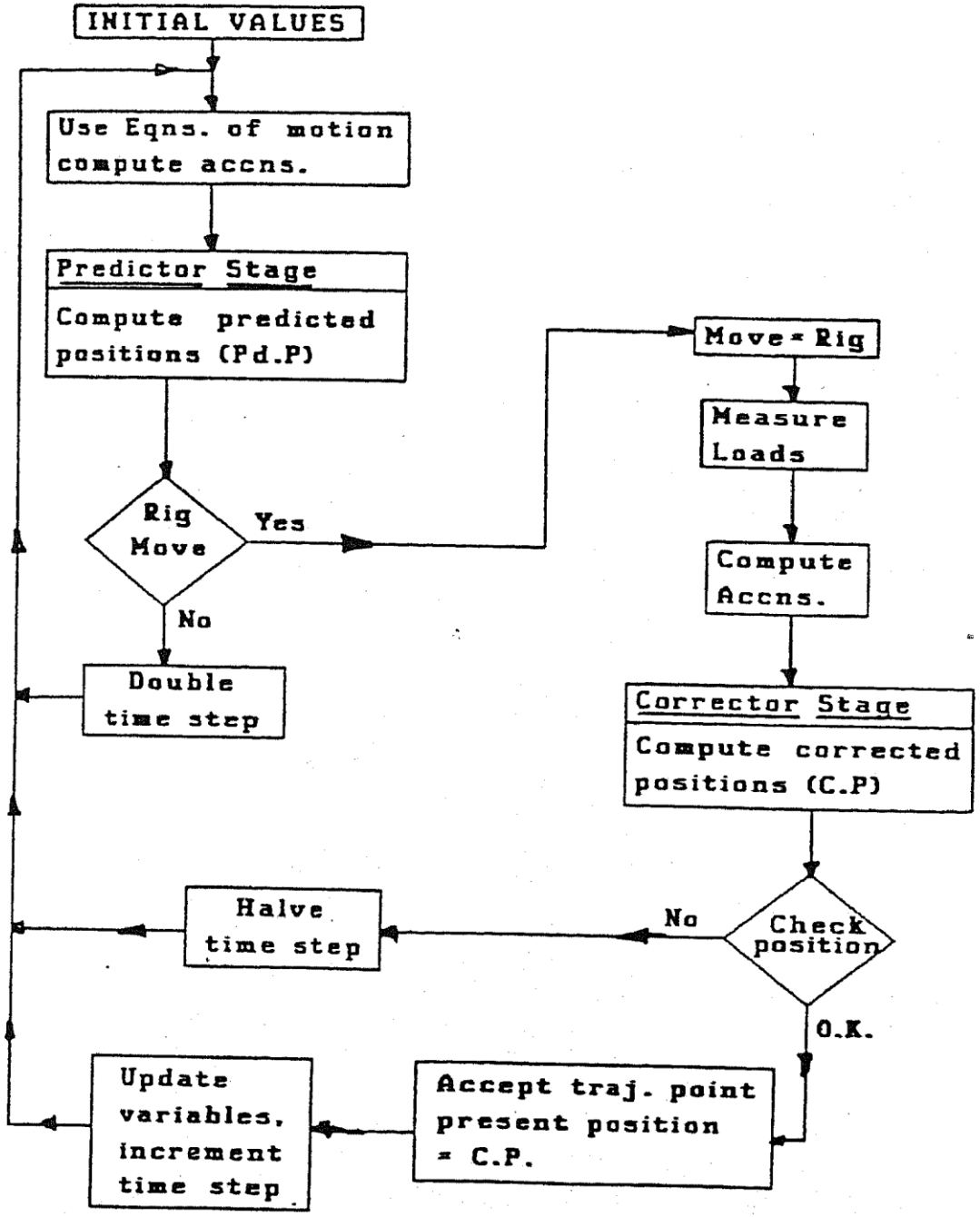
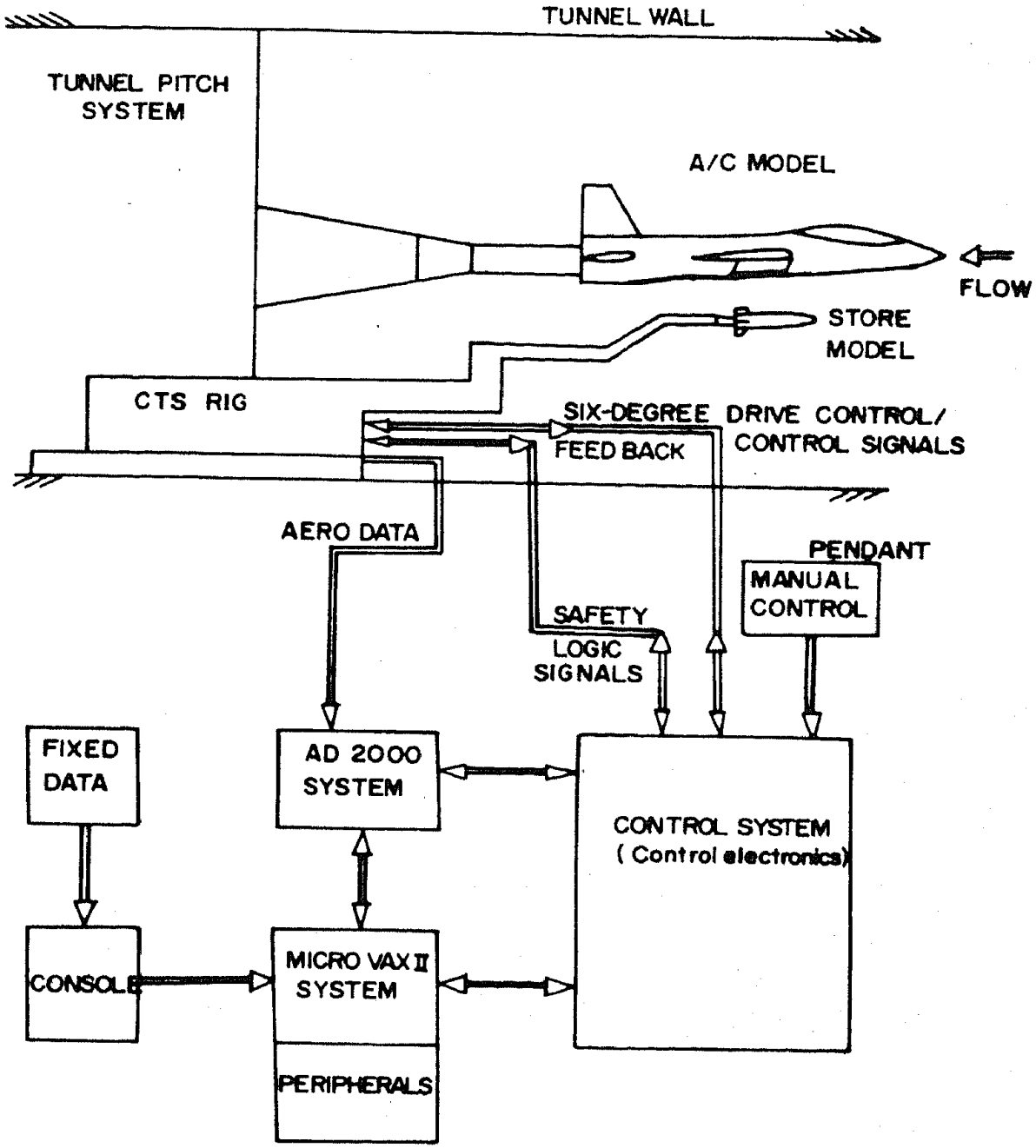
EXPERIMENTAL TESTS






INITIAL VALUES
Use Eqns. of motion compute accns.
Predictor Stage
Compute predicted positions (Pd.P)
Rig Move
Yes
No
Move Rig
Measure Loads
Compute Accns.
Corrector Stage
Compute corrected positions (C.P)
Check position
No
O.K.
Halve time step
Double time step
Accept traj. point present position = C.P.
Update variables, increment time step


TUNNEL WALL
TUNNEL PITCH SYSTEM
A/C MODEL
FLOW
STORE MODEL
CTS RIG
SIX-DEGREE DRIVE CONTROL/ CONTROL SIGNALS
FEED BACK
AERO DATA
PENDANT
MANUAL CONTROL
SAFETY LOGIC SIGNALS
FIXED DATA
AD 2000 SYSTEM
CONTROL SYSTEM (Control electronics)
CONSOLE
MICRO VAX II SYSTEM
PERIPHERALS