

Chapter One

Monday

Building 433—T Program
Lawrence Livermore National Laboratory
Livermore, CA

Gold, purple, and red streamers flowed across the airplane as it soared toward infinity, parting as the jet plowed through the multicolored atmosphere.

Without a sound, the contour-enhanced streamers sluiced over the swept-winged aircraft, skimming smoothly down the fuselage, skating unaffected over well-burnished seams and rippling over precisely calculated angles.

“Can’t you get the speakers on, Gary?” Hal Michaelson demanded, standing amidst the clouds.

At the rear of the craft, the streamers lifted off the metal skin, curling up like psychedelic wood shavings, then tumbled together in a growing turbulent vortex wake behind the plane.

Suddenly a screeching, whistling howl roared past Michaelson’s ears, rattling his teeth. “Too damn loud!” he yelled to his deputy.

Virtual Destruction

Outside the chamber, Gary Lesserec adjusted the volume. Michaelson could just picture him grinning with his stupid “gee whiz” expression. “Yeah, but it’s impressive, Hal. The Air Force weenies will love it.” Lesserec’s voice came over a loudspeaker implanted in the wall.

Michaelson stepped into the imaginary airflow, a looming titan intruding on the image. A canary-yellow strand of fluid whipped around his steel-gray hair without disturbing it, enveloping the bearlike researcher in the simulated airstream. At six feet six, his massive frame took up a large part of the wind-tunnel simulation. But the computers worked around him, as if he were a foreign object in the path of the aircraft.

“You’re sure we’re at max q?” Michaelson shouted out of the chamber. “This the best we can do?”

“We’ve calculated all the other possibilities—”

As usual, Michaelson paid no attention to the answer, battering ahead to see for himself, a jungle guide hacking away at the underbrush with his machete, unconcerned that someone might have already built a road.

Bluntly, he reached into the image and tugged on the nearest wing of the plane, sweeping back the airframe even farther than before. He watched with interest, like a toymaker adjusting one of his creations.

Within seconds the holographic airflow of streamers evolved, tangling like an angry storm. Supercomputers galloped through billions of calculations by the time Michaelson could blink. With motions dictated by a massive three-dimensional matrix of discretized Navier-Stokes equations, the streamers exploded in an unsteady burst, jumbling together and peeling away from the skin of the aircraft.

“So much for that,” Michaelson muttered.

“Hal,” Lesserec said with a sigh, “why can’t you ever just listen when—?”

Michaelson chose not to respond to his deputy’s carping and nudged the wing back to its original position. The aircraft felt flimsy, as if he could punch a hole through the illusion by moving too fast—but the fact that he could feel it *at all* made

the project far superior to anything else he had ever worked on. As he watched, the colored vortex streamers once again became stable, relaxed to flow smoothly over the airframe.

He grunted in annoyance. "I spotted the delay. It was just a simple modification—I shouldn't have noticed."

"Give us a break, Hal. This is a full-up simulation, with over a billion equations solved every second to bring you that flow!"

Michaelson chewed on his reply, but did not spit it out. He knew damned well how much supercomputer time he was gobbling, since he had masterminded the project since its inception. He had railroaded the work, been a slave driver, insisted on perfect performance—but he had to be even more skeptical than the Pentagon and On-Site Verification boobs would be. He wanted no warts to detract from his show. All Lesserec needed to know, though, was that it was slow.

"Okay then, enough kindergarten stuff. Switch away from the wind-tunnel simulation—give me the Nellis sequence."

Lesserec's voice came over a babble of other technicians scurrying to call up the new program. "Better strap in, Hal. Use one of the observation seats. We hooked this one up to the accelerometer."

"I'll be fine," Michaelson said, scowling. His pencil-thin moustache, which was supposed to make him look suave, tickled his lips.

"No, you won't, Hal," Lesserec's voice was insistent, vaguely paternal. The thought of red-haired and freckle-faced Gary Lesserec, who looked like chubby Jimmy Olsen with a hangover, being paternal to *him* made Michaelson want to laugh. "You're forgetting these Air Force pilots love to make people puke."

Michaelson grumbled, but he glanced behind him in the Virtual Reality chamber and found a row of seats padded with the currently chic teal fabric. Clicking his safety belt and feeling like a paranoid fool, he wiggled down in the seat, which barely held his large frame.

"Please remain seated at all times," the voice dead-panned over the intercom.

"Just hurry the hell up," Michaelson growled. "I've got a flight to Washington this afternoon."

Virtual Destruction

The holographic image of the airplane and the simulated flowlines disappeared like pixels going down the drain into the Twilight Zone, leaving him disoriented in a strange void as the new simulation booted up.

Michaelson felt as if he were lost and falling for a second as the swirled white cumulus clouds vanished beneath him—a powerfully odd sensation, he noted—when just as suddenly, he was transported into the cockpit of an Air Force fighter jet.

The repainted sky was blue and cloudless all around him, like a piece of crockery. An instrument panel magically appeared, complete with throttle, avionics package, and control stick. He reached forward for the controls.

The sky began to spin crazily around him. His stomach lurched as he “felt” a surge from the jet engines kick him in the small of the back. Just like a ride at Disneyland, but this was so much more, even if the audience wouldn’t grasp the difference. Wrapping his right hand around the control stick, Michaelson tried to steady the aircraft. The primitive part of his brain screamed that he was going to crash!

But his reason took over, as it always did. *Doesn’t feel flimsy at all*, he thought. Was it the adrenaline pumping through his body, or was the tactile response that much better in this simulation? He squeezed on the control stick, not too hard, but he definitely felt something solid there. No tactile-response gloves, no fake hardware—he was touching a matrix of electrostatically suspended microspheres, pattered according to the desired shape. It looked the same as some of the other expensive VR simulations, but the suspended microspheres could make you feel *anything* the computers could draw. It wasn’t real—but his instincts “knew” he was holding a control stick.

Michaelson didn’t have a chance to think any longer on the wonder of the upgraded chamber as a pair of jets roared overhead, just inches above the cockpit. Twin tailpipes, burning white with raw power, disappeared in the blue distance with a sound of fading thrust, like echoes going down a funnel. He flinched in his accelerometer seat as the sound reverberated over him, shaking the cockpit, stereo-adapted and appropriately projected from all

directions. The illusion was perfect. He felt the cold, hard rubber of an oxygen mask snug against his face. He felt his jet throb with the power of his imaginary engines, and the aircraft went into a roll along the programmed flightpath.

His muscles responded to violent curves, slamming him against the seat in tight top-gun maneuvers and screaming descents. Michaelson felt as if his teeth were jarring loose; but he was only sixty, and he intended to keep his own teeth for some time to come.

He raised his voice. "All right, Gary. Disengage the accelerometer part. I feel like I'm on the Star Tours ride at Disneyland."

"Oh, come on, Hal—we're much better than that!" Lesserec chided over the loudspeaker.

Michaelson's seat ceased its convulsions, and once again he sat back as an observer inside the fabric of the tactile scenario that completely engulfed him. When he was certain he wouldn't be thrown off balance by his own misguided equilibrium, Michaelson unbuckled and stood through the image, plowing through the aircraft's illusory control panel. All around him in the inverted bowl of sky, the dogfight continued to play out—the visual cues were enough to disorient him, but at least he experienced no physical motion to trip him up.

Walking to the center of the chamber, Michaelson raised his voice to be heard over the screaming jets in their air battle. "Okay Gary, now put me ten kilometers over the flight range, large scale so I can get a view from a distance."

The scene in the chamber flickered and bounced, like faulty reception on a television set.

Michaelson stood miles above the ground, his feet invisible through the clouds below. He had a sudden fairy-tale vision, like Jack and the Beanstalk with his own legs rising from the ground in a towering trunk.

Just above the clouds tiny fighter craft chased each other about the sky, around his ankles. Contrails spewed from their engines. Through torn openings in the blanket of clouds, Michaelson saw splotches of brown desert, barren mountains, and in the distance