The Invisible Forces That Make REACH 3D Garments Move Like Real Fabric

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For a garment to feel alive on a digital body, the software must understand fabric the way a master tailor does: not as a flat texture, but as a material governed by invisible mechanical forces. REACH 3D's motion animation engine is built around a complete physical model of cloth—one that calculates every major force a textile experiences in the real world. By solving these forces simultaneously and in real time, REACH 3D produces garment movement so accurate that many couture houses now trust it for final design sign-off before a single meter of cloth is cut.

Here are the core forces the engine considers, and why each one matters.

Stretch Forces (Tensile Resistance)

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Stretch forces control how much a fabric resists being pulled lengthwise (warp) or crosswise (weft), and how quickly it returns to its original shape.

In REACH 3D, every material carries two independent stretch stiffness values plus an elongation limit. A cotton poplin might allow only 2–3 % extension before seams would burst in real life, while a two-way stretch scuba can reach 80 % without permanent deformation. The engine continuously measures distance changes between neighboring particles in the simulation mesh and applies restoring forces proportional to those measured lab values.

The visible result? A T-shirt clings to the chest when the model inhales, then snaps softly back on exhale. A woven trench coat stays crisp across the back with almost no give. Without accurate stretch modeling, garments either look rubbery and bouncy or unnaturally rigid.

Shear Forces (Diagonal Distortion)

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Shear is the force that resists the fabric turning from a perfect square into a parallelogram—the sliding motion that happens when you twist a sleeve or when bias-cut silk falls across the body.

Most older 3D tools severely under-simulate shear, causing garments to look 'cardboard'on the bias. REACH 3D treats shear as a first-class constraint with its own stiffness and hysteresis curves. The engine allows (or restricts) diagonal distortion exactly as the real textile would, which is why a bias satin slip dress in REACH 3D drapes into liquid spirals while a stable wool gabardine holds a clean A-line with almost no twist.

Bend Forces (Flexural Rigidity)

Bending determines how sharply or softly fabric folds. A thick melton coat forms large, sculptural creases; a fine silk organza collapses into hundreds of tiny micro-pleats.

REACH 3D uses a discrete shell model with per-edge bending stiffness derived from the bend tester data stored in its material library. Critically, bending is directionally anisotropic: a twill denim bends far more easily along the twill line than against it, producing authentic diagonal break lines when a virtual jeans leg is flexed. The engine also models bend damping separately, so a heavy velvet curtain swings slowly and majestically while a lightweight chiffon flutters and settles almost instantly.

Compression and Buckling

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While most cloth resists tension, few systems correctly handle compression—the tendency of thick or padded fabrics to buckle inward when pushed. REACH 3D includes compression stiffness so that quilted jackets show realistic puckering at seams and puffer coats maintain their lofty volume even when the wearer sits.

Gravity

Simple in concept, but essential. REACH 3D applies true $9.81\ m/s^2$ downward acceleration to every particle. A 600 gsm wool coat hangs with authoritative weight; a 12 m/m silk chiffon barely notices gravity and instead floats on air currents.

Air Resistance and Wind

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Air drag is velocity-dependent and increases with the square of speed. The engine exposes controllable drag coefficients so that a silk georgette scarf billows dramatically in a gentle breeze while a structured canvas blazer barely flutters in a storm. Designers building virtual shows can paint vector wind fields across the scene—perfect for a finale gown that needs to catch a dramatic updraft on cue.

Friction and Collision Response

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Two types of friction are modeled:
- Fabric-on-skin (so a satin lining glides smoothly while a raw wool scratches and catches)
- Self-friction (so folds of a leather skirt stick slightly instead of sliding endlessly)

Collision detection runs continuously at sub-millisecond intervals, preventing even the tiniest penetration between cloth and body or between layers of the same garment. This is why long trains never pass through legs and why shirt collars sit perfectly on top of jacket lapels.

Inertia and Mass Distribution

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Every triangle carries its own mass calculated from the chosen fabric's areal density (gsm). Heavier hems fall faster, lighter bodices lag behind—a subtle but critical detail that gives garments their characteristic "swing."

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The Orchestration: Solving Everything at Once

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What elevates REACH 3D above research-grade simulators is that all of these forces are solved simultaneously using an extended Projective Dynamics solver running entirely on the GPU. There is no sequential "first stretch, then bend, then collision" pipeline that introduces artifacts. Instead, the engine finds a global equilibrium each frame that satisfies every constraint at once—exactly how real physics works.

The outcome is garment behavior that emerges organically rather than being scripted. A designer can grab a virtual sleeve, pull it sideways, and watch the entire jacket react realistically: shoulder seams tense, side panels shear slightly, the collar lifts a few millimeters, and when released, everything settles back with natural damped oscillation.

Because the forces are rooted in measurable textile science rather than artistic guesswork, the same simulation that powers a breathtaking virtual fashion show is trusted by factories for final production approval. The trench coat that swings perfectly on the digital runway will swing the same way on the customer who buys it six months later.

In the end, REACH 3D doesn't animate clothing—it lets physics do the work. And physics, when modeled this faithfully, is indistinguishable from magic.