Buried within the super powers of Mr. Fantastic, in the 20th Century Fox film Fantastic Four: Rise of the Silver Surfer, were many challenges not normally encountered with a regular animated photo real CG character. For one, he is able to convert the mass of his body into a completely pliable rubber-like state and able to stretch over 1,500 feet. He is also able to squash, flatten, and otherwise deform himself into basically any shape directorially imaginable. This unique ability became the focus of effects work for numerous all cg shots of Mr. Fantastic created at Hydraulx, generating some unique challenges along the way.

1 The Stretching Performance Challenge
The first specific challenge to overcome was modeling and rigging cartoon-like deformations while still looking anatomically realistic. We approached this by increasing our base geometry resolution to the limits, and binding within a layered and subdivided control hierarchy, with level of detail controls that could be adjusted on faster broader arcs or very fine levels; 3 levels of broadness existed for the arms legs neck and spine of the biped rig. Another major challenge was the shear number of various “forms” that Mr. Fantastic needed based on motion requirements for the film. We started with 9 variations of unique motion rigs, and ended the film with over 16 different variations of rigs for the Mr. Fantastic character. Needless to say, this became an incredible amount of work due to pliability of this character’s skin and his unique capability to deform into literally any shape. Some of the primary rigs created were a standard stretchy biped rig, an extreme stretchy biped rig, surface tangent based stretchy path rig, an extreme spline ik arm rig, a flattening and squashing rig, an inflating rig, along with many more shot specific rigs.

2 Custom Deformation and Pipeline Tools
Specific challenges required specific, yet procedural deformation techniques. In order to allow Mr. Fantastic to easily flatten and squash, yet still go through animation iterations, a custom squash deformer was written that used planar vertex projection normals, tangents and volume calculation techniques to squash a character against any surface at any angle. A surface derivatives based relaxation node was written in order to give a rubbery and smooth look to the geometry in even the most extreme distorted poses. A clamped spring based jiggle node was written for rubbery and elastic jiggle effects layered on top of animated poses. A spherical attenuation power curve weighted vertex masking deformer called the SphereOfInfluence deformer was written to allow any deformation effect to be blended in/out in completely non-linear space and time independent ways. A spherical vertex bulge/push field was written which allowed particle dynamic style effects to take place in a non-time dependent manner. A shot based sculpting pipeline was built in order to achieve any final stretching effects that otherwise became too shot specific to handle with other generalized tools. A turbulence and noise deformation node, along with automation, baking and cache time warping modification tools were also written for the very complex stretchy cloth simulation challenges that were ahead.

3 Super Stretchy Cloth Simulation
Mr. Fantastic also stretched the limits of our cloth simulation pipeline. The cg paradox was his cloth must fully stretch; could not tear, yet must still feel realistic. Combining physical simulation w/ fantastically pliable performance was challenging since he wore loose fitting clothing in many shots. We tried variations w/ dynamically driven displacement, smoothing geometry & setting key wrinkle poses, along w/ layered & blended low-resolution deformed simulations. These approaches were effective but did not yield the realism required. Simulating the resolution necessary was unrealistic on a 32 bit memory architecture, so much so that it justified expediting the upgrade of our cloth pipeline to use all 64 bit, allowing us to utilize amounts of memory we could only dream of. We were able to run multiple simulations at full resolution without hitting allocation limits, able to simulate scenes over 4x the geometric resolution, in the same amount of time; achieving multiple iterations and flexibility. Growing his clothing meant adjusting the length of the goal springs during a simulation. With a stretch meter built into our rigs, we were able to tell the solver the exact amount his limbs were stretching at any point in the animation. This allowed us to drive the simulation to an exact length. Multiple simulation wedges were run based on stretch lengths; wedges of time, and geometric areas of vertices were blended together using weighted vertex & time maps to achieve the final stretching cloth simulation. Time was split into chunks since different simulation parameters worked better over different ranges of time. The key was blending these simulations together across time, space, and action, while maintaining the dynamic physical nature of cloth in an apparently seamless manner.

4 Rendering & Integrating w/ Live Action & 2D
Achieving photorealistic extreme stretch, yet w/ very little texture distortion was the major challenge. Multiple color corrected live action plates taken at various camera angles were tracked and roto-animated as this live action footage was projected into a deforming texture reference skin space. These projections were then blended together and mixed within the shader itself, and additionally deformed and warped to integrate with the character's inhuman performance. An additional shader adjusted the lighting of the warped plate footage to match it's new 3D spatial motion. Projecting arrays of camera dependent live action plates along with driving and distorting texture space with blended texture repeats in the U and V directions based on the rig’s stretch meter length allowed us the ultimate solution for creating a photo-real Mr. Fantastic, yet yielding freedom of fully stretchy, pliable motion and deformation.

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