Virtual Assembly Using Haptic Force-Feedback Rendering

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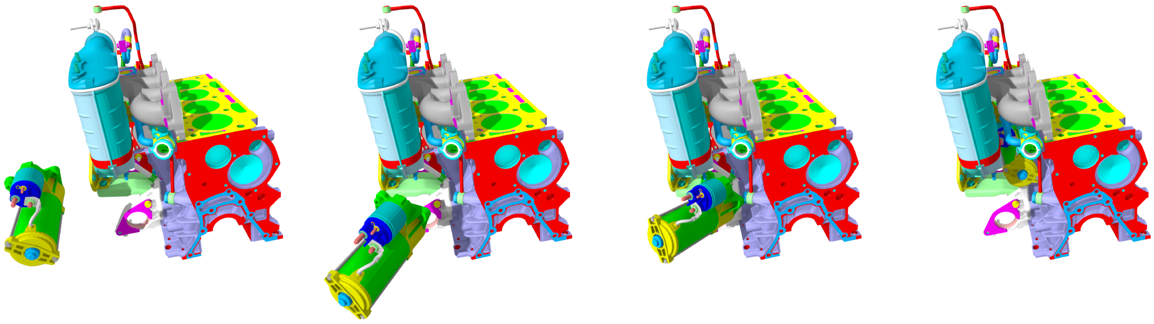

Figure 1: Virtual assembly of complex geometry: insertion of a car starter motor into the engine.

Six-DoF haptic rendering is useful for interactive applications in virtual assembly and maintenance of complex machinery, such as, for example, car engines and landing gears. Because mechanical components are often geometrically complex, such applications require efficient interactive simulation, involving collision detection and rigid and deformable object simulation. In simulations involving complex distributed contact, there are typically many simultaneous individual contacts, posing stability issues due to accumulated stiffness. In order for simulations to be useful, they must eliminate (or at least minimize) false-positives, i.e., paths that violate contact due to errors in the contact resolution algorithm. Friction is non-trivial, due to the large number of contacts and stringent time requirements. Similarly, preparing the signed distance fields and point clouds can take an unreasonably amount of time with models of realistic complexity. Even if the haptic rendering problem were to be completely solved, this alone is not sufficient for efficient training of virtual assembly, because users still need to be trained how to perform complex assembly paths.

In my talk, I will give recent advances on these problems in my group at the University of Southern California. I will discuss signed distance field generation, continuous collision detection, adaptive stiffness and friction. I will also discuss how to augment 6-DoF haptic rendering of contact to maximize virtual assembly training efficiency, by employing carefully selected visual and haptic guidance strategies.

Joint work with: Hongyi Xu, Danyong Zhao, Yijing Li, Mianlun Zheng.

References

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