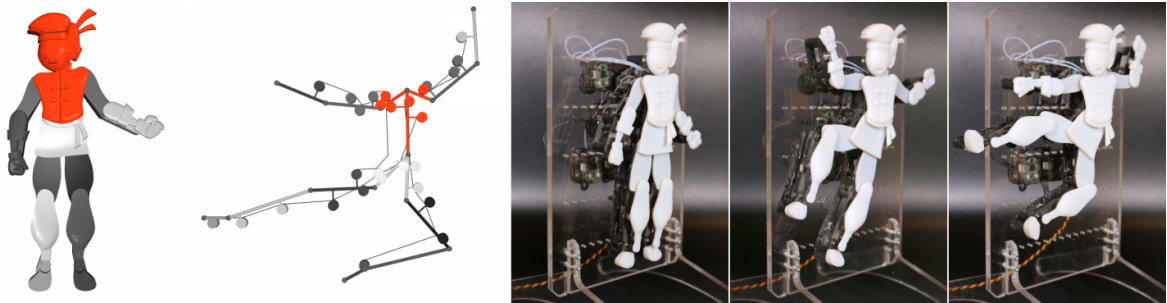


# Design method helps animated characters gain physical form

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Credit: Disney Research

Disney Research has developed a method for designing cable-driven mechanisms that help artists and hobbyists give physical form and motion to animated characters.

Assemblies of cables and joints make it possible to achieve desired motions and poses in a character, even when artistic preferences dictate limb sizes that make it infeasible to place motors at each joint. Cable-driven mechanisms also are suitable for devices, such as robotic hands, that must be small and lightweight to function.

"The advent of consumer-level 3D printing and affordable, off-the-shelf electronic components has given artists the machinery to make articulated, physical versions of animated characters," said research

scientist Moritz Bacher. "Our approach eliminates much of the complexity of designing those mechanisms."

The researchers demonstrated their [method](#) by designing a 2D puppet-like version of an animated character that is able to assume several desired fighting stances. They also used it to design a gripper for picking up light objects and a simple robotic hand with an opposable thumb.

They will present this method at SCA 2017, the ACM SIGGRAPH/Eurographics Symposium on Computer Animation July 28 in Los Angeles.

"A number of design tools developed over the past 30 years have enabled artists to breathe life into [animated characters](#), creating expressions by posing a hierarchical set of rigid links," said Markus Gross, vice president at Disney Research. "In today's age of robotics and animatronics, we need to give artists and hobbyists similar tools to make animated physical characters just as expressive."

Cables can only exert force in one direction—by pulling—so fully actuated joints demand two cables to move in both directions. In this case, the Disney Research team designed devices that weren't intended to interact with people. They sought to minimize the number of cables and thus incorporated springs into the joints to move them in the opposite direction when the [cable](#) tension was eased.

The team, supported by researchers from ETH Zurich, the Massachusetts Institute of Technology and the University of Toronto, developed a method in which a user designs a skeletal frame or other assembly of rigid links and hinges and then specifies a set of target poses for those assemblies.

The method then computes a cable network that can reproduce those

poses, initially generating a large set of cables—typically a thousand or more—with randomly chosen routing points. Redundant cables are then gradually removed. Next, the routing points are refined to take into account the path between poses and further reduce the number of cables and the amount of force necessary to control them.

In using the method to design and build its 2D "Fighter," the researchers showed that the mechanical character was able to achieve the desired poses with accuracy. The design for the lower body initially included 1600 cables; the number was then reduced in 25 seconds to eight; further refinement took just 181 seconds to reduce the number of cables to three.

The 2D gripper they designed and built was able to pick up the light objects it was designed to lift. The [robotic hand](#), with three fingers and a thumb, demonstrated that the method could be used to combine cable drives in more than one plane.

**More information:** "Designing Cable-Driven Actuation Networks for Kinematic Chains and Trees-Paper" [[PDF, 9.72 MB](#)]

Provided by Disney Research

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