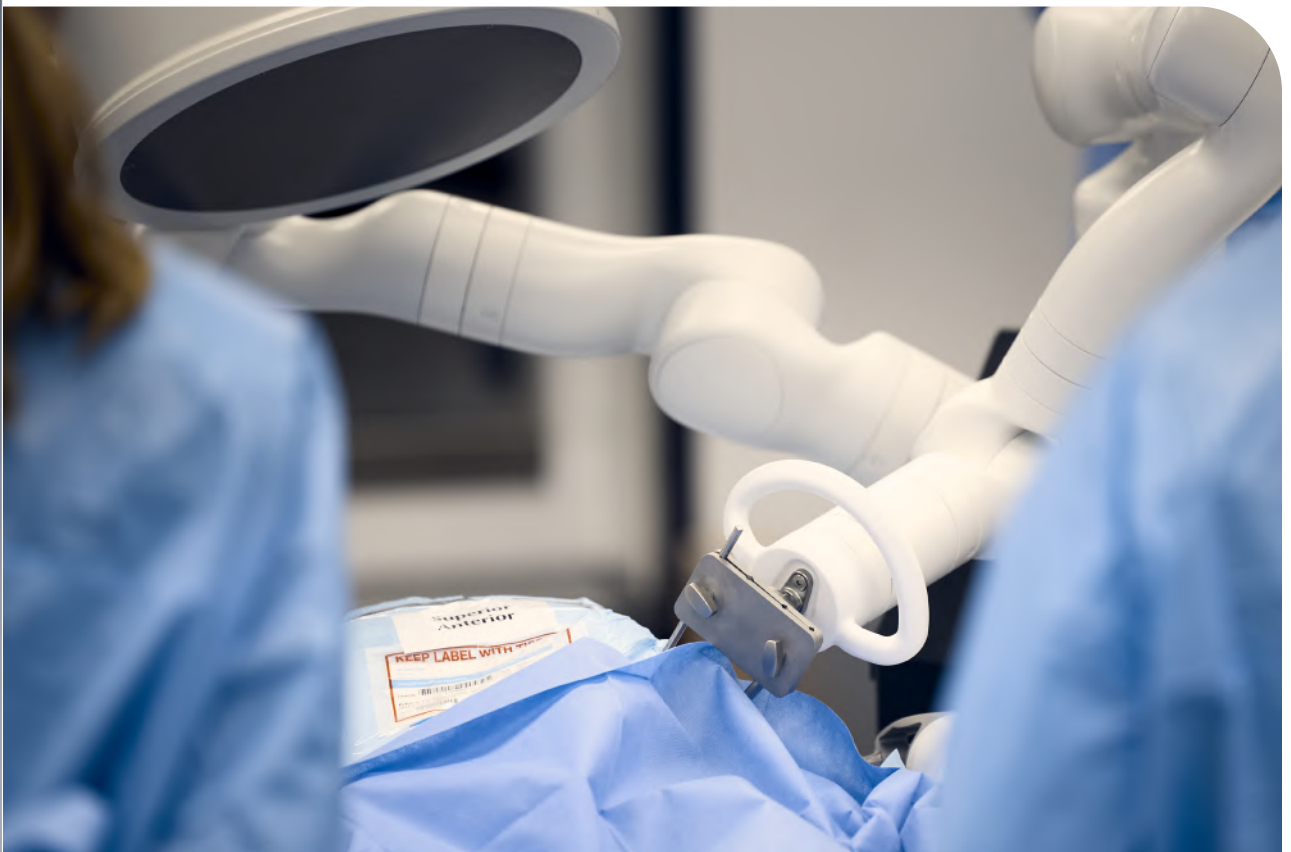


Built for MedTech.

KIMA in a Multi-Arm Prototype for Pelvic Fracture Surgery

Three KIMA arms on a single cart: how metamorphosis designed its system with NVIDIA Isaac for Healthcare, *in silico* then in the real world.



At a glance

Building a surgical robot means designing an environment and workflows that fit several arms, an imaging system, and a surgical team into the same limited space.

Metamorphosis, a trackerless surgical navigation company based in Paderborn, Germany, took on this challenge with Kinova KIMA and NVIDIA Isaac for Healthcare. The result is an investigational image-native robot prototype in which three KIMA arms, mounted on a single mobile cart, each take on a defined role in a pelvic fracture procedure.

Partner	metamorphosis, Paderborn, Germany
Application	Pelvic fracture surgery (investigational prototype)
Kinova technology	Three KIMA arms on one mobile cart, sharing one controller
NVIDIA technology	NVIDIA Isaac for Healthcare (SW) and NVIDIA DGX Spark (HW)
Status	Investigational prototype, not for clinical use or commercial sale

Designing Around the C-Arm

The Challenge

Pelvic fracture surgery brings several tasks together around the patient: repositioning bone fragments, guiding instruments along planned trajectories, and acquiring X-ray views to verify each step. A robotic system that supports this workflow needs multiple arms, and those arms must share the space with the patient on the operating table, the C-arm imaging device, and the surgical team.

Metamorphosis introduced a further design requirement. OneX3D, the technology powering Image-Native Robotics, uses intraoperative X-ray images as the system's reference rather than external

patient trackers. This makes C-arm access a central design consideration: the robotic arms need to be compact enough to operate alongside the C-arm while leaving room for the surgeon to acquire the required X-ray views.

To address these spatial constraints, the team uses a simulation-based integration loop to evaluate arm placement, attachment designs and C-arm positioning. This enables rapid iteration on the physical layout before components are manufactured.

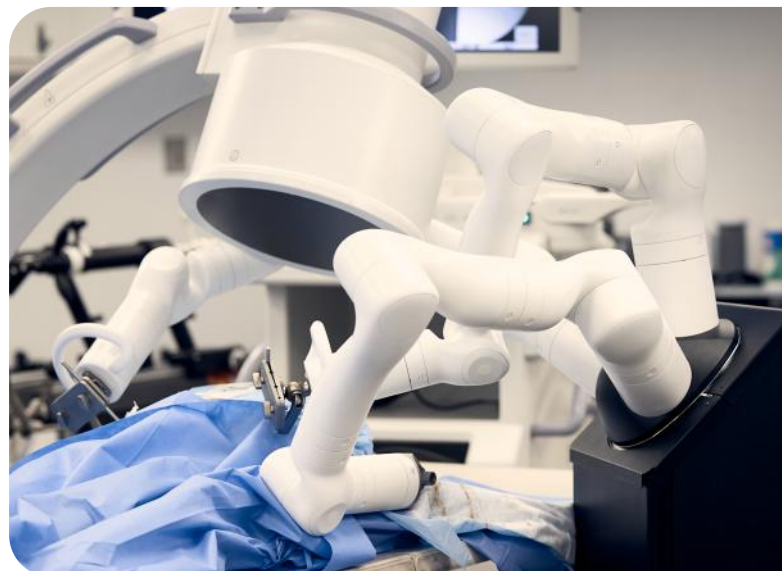
The Approach

Why Three Arms? What Does Each KIMA Arm Do?

Many existing orthopedic surgical robotic platforms use a single robotic arm, primarily for instrument positioning and guidance. More complex workflows, such as pelvic fracture surgery, can benefit from multiple arms working together to perform complementary tasks. In the pelvic fracture workflow under investigation, the three KIMA arms are mounted on a single mobile cart positioned beside the operating table. Each arm has a defined role:

- 1-2 Arms 1 and 2, fracture reduction**
Two arms provide the forces and precise movements needed to reposition fracture fragments and hold them in place.
- 3 Arm 3, trajectory guidance**
A third arm positions a guide sleeve along a planned trajectory, so the surgeon can insert guide wires for subsequent screw placement.

The procedure also includes guidance for aligning the C-arm with the corresponding validation views, so the surgeon can supervise at each step.





"KIMA's compact arms and small mounting footprint enabled configurations that we had not been able to realize with other medical OEM arms we had considered."

Arno Blau, CTO, metamorphosis

CAPABILITIES

KIMA Features at Work

Each KIMA characteristic answered a specific need of the system:

- 1 Compact arms and a small mounting footprint.**
KIMA enabled multi-arm configurations that the team had not been able to achieve with the other medical OEM arms it had considered. The mobile cart that carries the system was originally designed for one industrial arm. With KIMA, it now holds three.
- 2 One controller for up to four arms.**
Daisy-chaining the arms to a single controller reduces the space needed for controllers and power supplies inside the cart.
- 3 Force-torque sensing integrated at the flange.**
The built-in sensors support hand-guiding without separate sensors on each attachment. They also allow the system to check whether an attachment has made contact with an expected surface, an additional check that the physical interaction is consistent with the system's registration.
- 4 Software designed for medical applications.**
Its focus is on direct arm control.

“The availability of KIMA as a sim-ready USD asset in Isaac for Healthcare made it straightforward to integrate the arms into this environment and begin exploring configurations. Support from the Kinova and NVIDIA teams helped us bring the setup together quickly.”

Arno Blau, CTO, metamorphosis

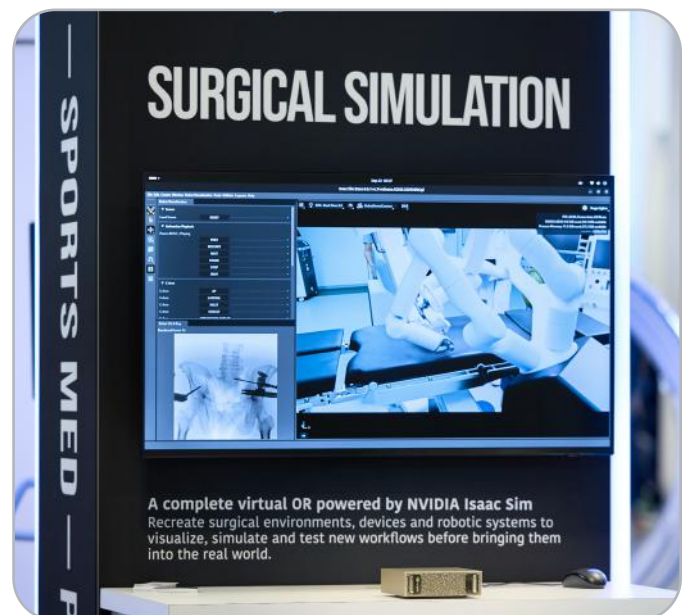
SIMULATION

Designed in Simulation First

Because imaging and robot motion are closely linked in this system, metamorphosis needed to study both in the same environment. The team built a virtual operating room with NVIDIA Isaac for Healthcare, combining physics-accurate and photorealistic simulation with its own X-ray imaging simulation. The entire simulation runs locally on NVIDIA DGX Spark, a powerful yet compact desktop supercomputer.

3D models of the KIMA arms are provided as openly available sim-ready OpenUSD assets in Isaac for Healthcare. Metamorphosis could therefore place the arms in its virtual operating room and start testing configurations right away, with support from the Kinova and NVIDIA teams.

As part of the design optimization that metamorphosis was able to achieve in simulation, the team explored cart placements that accommodate the X-ray viewing angles required by the workflow while keeping the arms within a suitable working range. It also iterated on attachment geometry so the arms could reach and work at the intended locations. Imaging access and robotic reach informed the design together.



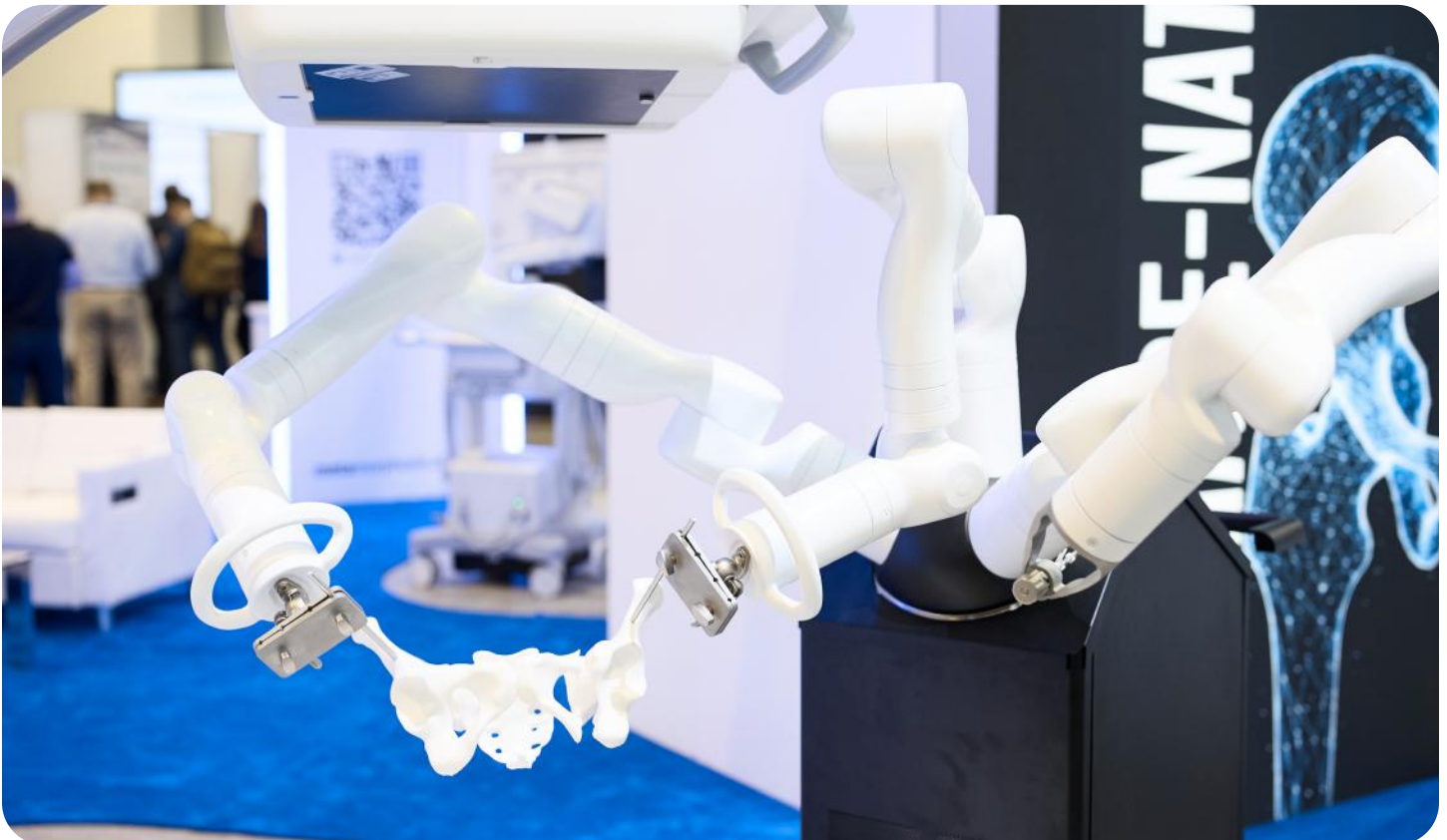
From a development perspective, the virtual NVIDIA Isaac environment provided an early integration point for the robotics stack itself. Developers could start building and testing control, perception and workflow logic before the complete physical system existed, with the simulation becoming a shared foundation from which further software and hardware development evolve.

From Virtual Operating Room to Anatomy Lab

Then the physical prototype quickly followed. At the Orthopaedic Trauma Association (OTA) 2026 Annual Meeting, metamorphosis presented the three-arm system alongside its virtual counterpart. The team also explored the system's handling with surgeons in a "wet lab", with the operating table and X-ray equipment in place, and acquired X-ray images showing the anatomy and the robot attachments. Observations from these sessions were then carried back into Isaac Sim.

The project established a repeatable development process:

- 1 Investigate configurations virtually.
- 2 Refine the physical design.
- 3 Evaluate handling and imaging access with the assembled system.



| In Their Own Words



Peter Schreier, Ph.D., CEO, metamorphosis

Kinova: What would you tell a company developing a similar system?

"Start with the surgical workflow and build the system around what it requires. For us, that meant using the X-ray image as the reference and finding hardware that gave us the flexibility to work around the C-arm in a compact multi-arm configuration."

Kinova: What role did simulation play?

"By bringing robotic motion, camera imaging, and our own X-ray simulation into a single virtual environment, we can explore complex surgical workflows before building physical prototypes. This dramatically accelerates development and allows us to explore configurations that would be difficult to evaluate experimentally."

Looking Ahead

Metamorphosis plans to further develop its Image-Native Robotics approach for pelvic fracture surgery and explore its application to additional surgical workflows, including spine surgery. The long-term vision is to bring imaging, navigation, and robotic control together in increasingly capable systems that can assist surgeons with complex procedures.



"Our role is to give medical device innovators a robotic platform they can build on, so they can focus on what makes their system unique. Metamorphosis shows what that looks like: by starting with KIMA in NVIDIA Isaac for Healthcare, they could shape a three-arm system in a virtual operating room before taking it into the lab."

François Boucher, VP Business Development, Kinova





About Kinova

Kinova is a global leader in designing and manufacturing robotic arms for various applications in the Professional, Academic, Medical, and Assistive markets. Our mission is to provide humanity with robots that empower people to achieve the extraordinary, every day. KIMA, Kinova's medical robotics platform, is built for the operating room.

About NVIDIA Isaac for Healthcare

NVIDIA Isaac™ for Healthcare is a platform purpose-built for developing healthcare robots. Built on NVIDIA's three-computer framework for Physical AI, it features pre-trained models, physics-based simulation, synthetic data generation pipelines, and accelerated runtime libraries. Isaac for Healthcare supports developers across the entire workflow, from collecting and curating data to building and testing AI models in realistic simulated environments, and deploying intelligent, low-latency robotic applications at the edge. Its library of sim-ready medical assets includes 3D models of the Kinova KIMA arms.



About metamorphosis

Founded in 2018 and based in Paderborn, Germany, metamorphosis develops trackerless surgical navigation and Image-Native Robotics. Its technology powers VELYS™ Trauma AI-Assisted Surgery by DePuy Synthes. The company's approach uses intraoperative X-ray images as the reference for navigation and robotics, without external patient trackers.



metamorphosis: metamorphosis.ai

NVIDIA Isaac for Healthcare: developer.nvidia.com/isaac/healthcare

Isaac for Healthcare documentation and assets: isaac-for-healthcare.github.io

Investigational status. The three-arm robotic system described here is investigational and is not cleared or approved by the U.S. FDA or available for commercial sale in any jurisdiction. It is not approved for clinical use.

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