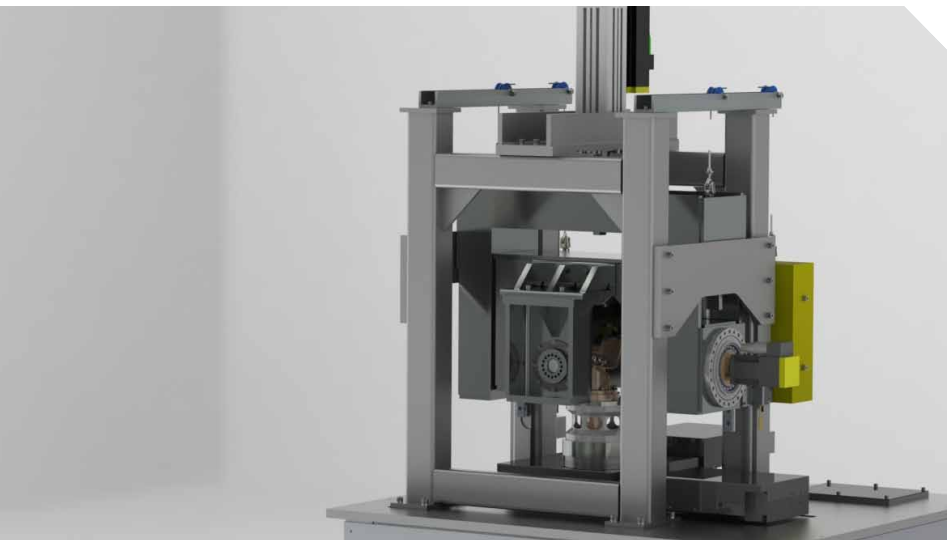


Prosim Universal Joint Simulator

Benefiting from the programme of work carried out on the FP7 Life Long Joints Project, the Prosim Universal Joint Simulator represents a significant breakthrough in the ability to synthesise adverse wear testing scenarios of orthopaedic implants, in line with the requirement to run an additional 5 million cycles of adverse wear as part of a wear testing programme for an implant being submitted for approval.

The simulator has been designed to accommodate the most extreme adverse wear scenarios, including force and displacement controlled microseparation (applying a force of 1.5kN both medial-lateral and anterior-posterior translations), continual adverse loading (running – 8kN/2.5Hz), stumbling, (using Georg Bergmann’s data – 11kN),

acetabular cup angulation (varied in-situ from 30° to 65°) and retroversion-anteversion (varied in-situ from -30° to +30°). The innovative design of a new six axis load cell also enables a full femoral stem to be mounted in the simulator and instrumented for wear and tribo-corrosion studies.



Left:
Front/Side View

Below:
Flexion/Extension Rocker
and Sample



Key Features:

- an innovative six axis load cell (mounted under the lower sample holder) enables the mounting of full femoral stems
- from 30° to 65° acetabular cup angle adjustment (in-situ)
- up to $\pm 30^\circ$ retroversion-anteversion angle adjustment of acetabular cup (in-situ)
- peak axial loading for single cycle of 11kN (but not continuous)
- simple user programmability of any articulation/load cycle enabling up to 15 cycles to be combined to replicate the activities of daily living
- capable of running programmed sequences of walking, jogging, stumbling, running and periods of rest
- operating frequency of programmable motions of up to 2.5Hz
- three additional analogue input and output channels
- in-built cycle synchronisation with external electrochemistry equipment
- test fluid temperature is maintained at $37^\circ\text{C} \pm 2^\circ\text{C}$ using a pump-based system
- real-time logging of position and load allows instant verification of test cycle
- clinically and physiologically representative testing

Prosim Universal Joint Simulator

The Prosim Universal Joint Simulator is a single station machine designed for the reliable and repeatable testing of a wide array of implants and cadaveric samples, including hips, knees, spines, shoulders, ankles, elbows and more. The simulator provides researchers and designers/ developers of replacement joints with a cost-effective and accurate means of generating wear, friction, fatigue and biomechanical data under realistic in-vivo simulated conditions.

All six axes of the Prosim Universal Joint Wear Simulator are electromechanically driven, using a combination of motors, drives and gear boxes. This enables the simulator to very closely follow any demand waveform however demanding it may be.

The Prosim Universal Joint Simulator operating envelope can be summarised as follows:

Axis	Knee		Hip		Spine	
	Load/Motion	Envelope	Load/Motion	Envelope	Load/Motion	Envelope
1	Axial Loading (femoral head)	Program up to 11kN (tension & compression)	Axial Loading (acetabular cup)	Program up to 11kN (tension & compression)	Axial Loading (superior face)	Program up to 11kN (tension & compression)
2	Flexion Extension (femoral head)	Program to +40°/-120°	Flexion Extension (acetabular cup)	Program to +40°/-120°	Flexion Extension (superior face)	Program to +40°/-120°
3	Anterior Posterior Translation (tibial tray)	Program to ±25mm ±1500N 10µm resoln	Anterior Posterior Translation (femoral head)	Program to ±25mm ±1500N 10µm resoln	Anterior Posterior Shear (inferior face)	Program to ±25mm ±1500N 10µm resoln
4	Medial Lateral Translation (tibial tray)	Program to ±25mm ±1500N 10µm resoln	Medial Lateral Translation (femoral head)	Program to ±25mm ±1500N 10µm resoln	Lateral Shear (inferior face)	Program to ±25mm ±1500N 10µm resoln
5	Tibial Rotation (tibial tray)	Program to ±40°	Interior Exterior Rotation (femoral head)	Program to ±40°	Axial Rotation (inferior face)	Program to ±40°
6	Abduction Adduction (tibial tray)	Program to ±40°	Abduction Adduction (femoral head)	Program to ±40°	Lateral Bend (inferior face)	Program to ±40°

Prosim Universal Joint Simulator



Left:
Full Stem Sample Hip Joint

Below:
Single Station Universal Joint Simulator



The simulator fully meets the requirements of:

- ISO14242-1 - implants for surgery – wear of total hip-joint prostheses – Part 1: loading and displacement parameters for wear-testing machines with load control and corresponding environmental conditions for test
- ISO 14243-1 - implants for surgery – wear of total hip-joint prostheses – Part 1: loading and displacement parameters for wear-testing machines with load control and corresponding environmental conditions for test
- ISO 16402 – flexural fatigue testing of acrylic resin cement
- ISO 14243-3 - implants for surgery – wear of total knee-joint prostheses – Part 3: loading and displacement parameters for wear-testing machines with displacement control and corresponding environmental conditions for test
- ISO 18192-1 - implants for surgery - wear of total intervertebral spinal disc prostheses ('TDR' hereafter) - Part 1: loading and displacement parameters for wear-testing machines and corresponding environmental conditions for test
- ISO 7206 - endurance properties of stemmed femoral components
- ISO 14879-1 - endurance of tibial trays
- ASTM F2790 – characterisation of motion preserving lumbar total facet prostheses
- ASTM F2777-10 - tibial insert endurance and deformation under high flexion
- ASTM F2028 – dynamic evaluation of glenoid loosening

Prosim is able to offer customisation of its simulators to meet client's specific testing requirements.