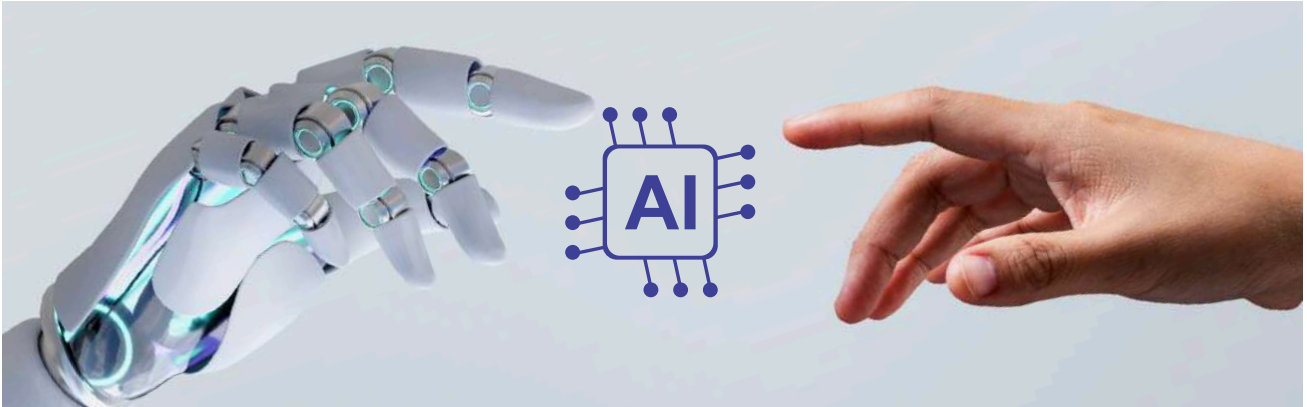# Waterjet Edge

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Cognitive Insights Newsletter

From the Desk of 2Do

Artificial intelligence has touched our life in multiple ways , in this regard it is good news for the waterjet industry which has always been welcoming to cost effective productive technology to adopt. The vast majority of the industry are tech enthusiasts & visionaries and therefore early market adopters !

Read on as we explore the exciting commencement of AI adoption in the waterjet cutting industry in this edition.

Industry Intelligence

AI & Waterjet Cutting in India: The Next Leap Forward

Artificial Intelligence is quietly but decisively reshaping the waterjet cutting industry in India. What was once considered a high-end capability reserved for advanced manufacturing is now becoming accessible to small and medium job shops across the country. From predictive maintenance to intelligent nesting and real-time quality inspection, AI is steadily transforming productivity, reducing costs, and elevating cutting performance.

India, with its mix of legacy machines, refurbished imports, and rapidly growing CNC ecosystem, is uniquely positioned for this shift.

Waterjet cutting in India faces a unique set of challenges—high production demand, diverse materials, skill shortages, and cost pressure on consumables. AI addresses these pain points directly.

Why AI Matters Now in Waterjet Cutting

1. Predictive Maintenance for Pumps and Components

High-pressure pumps are the heart of every waterjet system. AI-powered sensors now monitor vibrations, pressure fluctuations, seal wear, and temperature changes to predict failures before they occur.

For Indian job shops running older OMAX, Flow, YC, or Indian-built machines, this can drastically reduce downtime and repair cost.

In this newsletter you can expect:

Industry Intelligence

Stakeholder Spotlight

Case of the Month

Ask an Expert

Marketplace & Innovations

Training & Events

2Do Corner

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2. Smart Nesting That Saves Material

AI-driven nesting engines optimize sheet layouts more efficiently than traditional CAM software.

Shops working with stainless steel, aluminum, titanium, stone, or ceramic are already reporting:
- **5–15% reduction in raw material usage**
- Faster programming time
- More accurate cost estimation for quoting jobs

3. AI-Enhanced Cutting Path Optimization

AI models analyze kerf, taper, speed changes, and material behavior to produce superior cutting paths. For shops dealing with mixed materials—from metal fabrication in Pune to granite inlay in Jaipur—this means cleaner edges, reduced rework, and higher throughput.

4. Real-Time Vision Inspection

Cameras combined with AI now detect:
- Taper or overcut
- Garnet feed irregularities
- Jet wander
- Insufficient piercing
- Misalignment in stone inlay

This is especially important for shops with limited skilled operators.

Where India Is Adopting AI the Fastest

✔ **Job Shops**
Driven by the need to stay competitive, job shops in Gujarat, Maharashtra, Tamil Nadu, and Karnataka are leading AI adoption—especially for nesting, quoting, and predictive maintenance.

✔ **OEMs & Aerospace**
High-precision industries are integrating AI for repeatability, traceability, and part inspection.

✔ **Machine Builders & CNC Integrator's**

Several Indian machine builders are experimenting with:
- Smart dashboards
- IoT-enabled controllers
- Remote service monitoring
- Consumption analysis (garnet, water, power)

While still early, this signals a new generation of "AI-ready" waterjet machines.

The India Opportunity: A Global Niche
India has one of the world's largest bases of refurbished and locally assembled waterjet machines. This creates massive potential for **low-cost AI retrofit solutions**, including:

- Predictive maintenance kits
- Vision-based alignment for stone inlay
- Automatic cost estimation tools
- Operator-assist AI systems (voice + WhatsApp integration)
- Garnet optimization modules that reduce abrasive consumption

These innovations can be designed in India and deployed globally.

The Bottom Line
AI is not here to replace waterjet operators—it is here to empower them.

With improved reliability, optimized material usage, faster quoting, and higher cutting accuracy, AI is set to become the defining competitive edge for Indian waterjet users over the next five years. The shops and machine builders who adopt early will lead the next wave of productivity and precision in the Indian waterjet industry.

Source: 2Do Marketing Research

Stakeholder Spotlight

WIN WIN WATERJET CO.,LTD
LEADING THE HIGH-END WATERJET CUTTING TECHNOLOGY
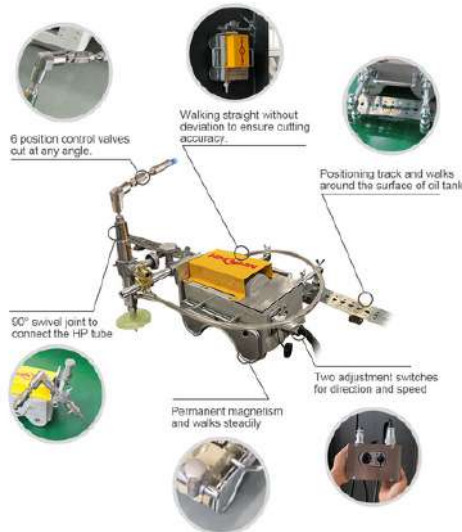
Portable Waterjet Cutting Machine
Brand: Winwin
Model: Track type electric portable waterjet
Cutting precision: ±0.1mm
Control accuracy: ±0.01mm
Repositioning accuracy: ±0.05mm

6 position control valves out at any angle.

Walking straight without deviation to ensure cutting accuracy.

Positioning track and walks around the surface of oil tank

90° swivel joint to connect the HP tube

Permanent magnetism and walks steadily

Two adjustment switches for direction and speed

Supporting Equipment: Portable cutting car
Intensifier pump
Cooling system
Water purification system
Abrasive tank

Portable water jet cutting machines offer a cost-effective, environmentally friendly, and adaptable solution for tasks such as cleaning contaminated surfaces, removing burrs, and cutting off rust. Designed for use in hazardous conditions like the oil industry, construction tunnels, and pipelines, these machines deliver high-pressure water and velocity, making them capable of cutting through any type of material.
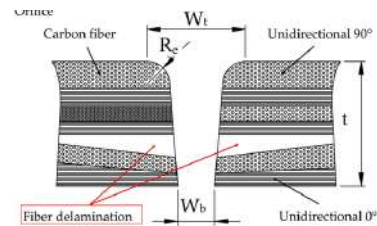
Applications You Can Cut

Source : Winwin

Case of the Month

Artificial Intelligence Model Used for Optimizing Abrasive Water Jet Machining Parameters to Minimize Delamination in Carbon Fiber-Reinforced Polymer

Abstract
This study introduces an artificial neural network (ANN) model for optimizing process parameters to reduce the chances of delamination in carbon fiber-reinforced polymer (CFRP) materials during abrasive water jet (AWJ) piercing. AWJ is a proper method for cutting CFRP. The initial step in this process is AWJ piercing, which creates entry holes in the material to facilitate further cutting operations. However, AWJ piercing is particularly challenging due to the high energy applied to the material. If it is not properly controlled, this high-energy impact can cause material delamination. Avoiding CFRP delamination is a critical aspect when expensive parts are processed with AWJ, particularly in the aerospace and automotive industries. This can compromise the CFRP workpiece, and this induces extra costs for rework. The ANN model was trained using backpropagation to predict delamination. It features a feed-forward architecture that balances model complexity and performance. Validation showed that the ANN model effectively predicted optimal process parameters, eliminating delamination in machined CFRP parts. This study underscores the potential of ANNs in enhancing AWJ piercing processes and provides a robust and reliable method of improving the quality of CFRP parts.

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Download their research paper as a pdf
Source : mdpi

Ask an Expert

Q: What role can a waterjet cutting operator play in the AI industry?

A: Artificial Intelligence is rapidly entering the waterjet cutting ecosystem—through automated nesting, predictive maintenance, adaptive cutting, and even AI-generated G-code. However, the question is becoming increasingly important one. The answer is: **a critical one.**

AI systems may automate tasks, but they urgently need real-world expertise to become reliable. This is exactly where operators add irreplaceable value.

1. Operators Help AI Learn Real Cutting Behavior
AI does not understand the subtleties of:
- Nozzle wear
- Taper under different pressures
- Jet lag in intricate contours
- Material variability
- Pump behavior at different loads

Operators provide this missing intelligence.

Their daily observations—sound, vibration, edge quality, kerf variation—help AI engineers calibrate models and improve accuracy.

2. Validating AI-Generated G-Code
As AI tools begin generating tool paths, operators act as the safety and practicality checkpoint. They evaluate:
- Pierce point suitability
- Safe lead-ins
- Sensible feed rates
- Clearance and fixture constraints
- Machine-specific limitations

Without operator verification, AI-generated G-code is incomplete and risky.

3. Supplying High-Value Data for AI Models
AI in manufacturing needs real shop-floor datasets. Operators naturally produce:
- Parameter logs
- Cut quality notes
- Consumable wear records
- Error histories
- Material response observations

This makes the operator a data contributor for machine learning and predictive models.

4. Supervising AI-Assisted Cutting Systems
Modern waterjet machines already include AI-like features such as:
- Adaptive feed correction
- Taper compensation
- Automatic kerf prediction
- Smart nesting

- Predictive pump maintenance

Operators ensure these systems are applied correctly, monitor deviations, and fine-tune the process using real experience.

5. Supporting Robotics & Digital Twin Applications
AI-driven manufacturing increasingly involves:
- Robotic waterjet trimming
- 5-axis waterjet cells
- Virtual cut-path simulations
- Digital twin analysis

Operators bring domain knowledge that prevents simulation errors and unsafe robotic paths. Their insight ensures artificial intelligence aligns with physical reality.

6. Building AI-Ready Manufacturing Workflows
AI teams often lack ground-level production insight. Operators help them understand:
- Actual cycle times
- Machine availability patterns
- Material handling constraints
- Practical layout flow

This input is crucial for AI scheduling, automation design, and optimization.

Summary
A skilled waterjet operator contributes to AI in three high-impact ways:

1. As a Knowledge Source : Teaching AI the physics and behaviour of real waterjet cutting.

2. As a Verifier : Checking and validating AI-generated toolpaths and processes.

3. As a Supervisor : Running and improving AI-assisted manufacturing operations.

AI will automate repetitive tasks—but the operator's judgement, intuition, and process wisdom remain essential. This makes the waterjet operator not only relevant, but central to the AI-driven future of precision manufacturing.

Source : <u>2Do Consultancy</u>

Marketplace & Innovations

AI, G-Code & the Future of Waterjet Cutting in India

Across India's fabrication, aerospace, stone, and precision engineering sectors, a silent revolution is taking place: Artificial Intelligence is beginning to influence how G-code is generated, optimized, and executed on waterjet cutting machines. Traditionally dependent on CAM software and operator experience, G-code programming is now being augmented by AI systems such as ChatGPT and domain-trained machine learning engines.

This shift is not about replacing operators—it is about giving every shop, from micro job shops to high-precision OEMs, access to a digital assistant that understands drawings, materials, and machine behaviour with remarkable accuracy.

AI as a New Partner in G-Code Programming

AI tools can now read design descriptions, DXF files, or even hand-drawn sketches and produce usable G-code for waterjet cutting. What earlier required multiple steps—CAD drafting, CAM processing, toolpath planning—can now be compressed into one conversational layer.

AI can generate:
- Cutting paths
- Pierce sequences
- Lead-ins and lead-outs
- Kerf compensation
- Corner slowdowns
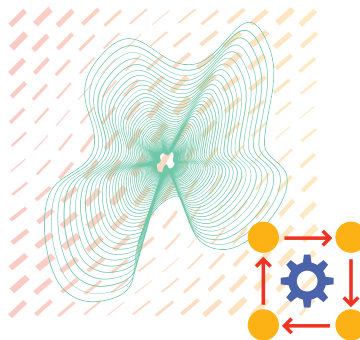- Safe rapid movements
- Material-specific feed strategies

For simple 2D jobs, the AI can write full G-code directly from operator instructions. This is a powerful capability for small workshops or new operators who are still learning CAM software.
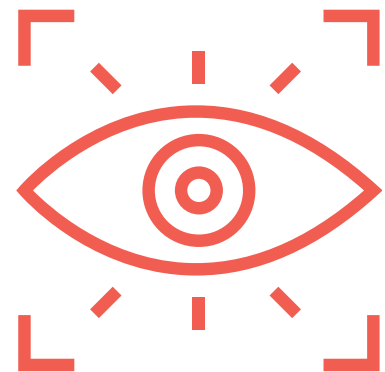
AI for G-Code Optimization: Smarter, Faster, Cleaner Cuts

One of the biggest gains comes from AI's ability to analyze and improve existing G-code. By studying cutting behavior, taper, pierce success, and speed consistency, AI engines can suggest improvements such as:

- Removing redundant rapids
- Re-ordering cuts to stabilize the sheet
- Adjusting speed for radii and tight corners
- Enhancing edge quality based on material thickness
- Improving taper compensation logic
- Identifying missing or incorrect height commands
- Ensuring minimal sheet vibration for fragile materials

This effectively makes AI a second operator—one who never gets tired and can read thousands of lines of code in seconds.

AI Vision + G-Code: Closing the Loop

The next leap is AI-enabled vision, where cameras mounted on the cutting table guide the G-code itself. AI vision can:
- Detect sheet skew and auto-align the program
- Identify usable scrap areas for micro-nesting
- Assist stone-inlay alignment (a uniquely Indian application)
- Monitor the cut in real time and suggest corrections
- Sense garnet issues and pierce failures

This closes the loop between programming → cutting → feedback, allowing machines to behave more intelligently even without controller upgrades.

What This Means for India

India has a huge installed base of refurbished and mixed-controller waterjet systems. Many operate with limited CAM resources and rely heavily on skilled operators. AI brings a rare opportunity to:
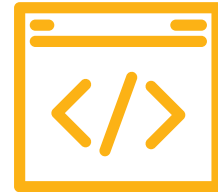
- Reduce programming dependency
- Upgrade old machines through software, not hardware
- Lower training effort for new operators
- Improve cutting consistency across shifts
- Reduce scrap and consumable costs
- Enhance competitiveness of Indian job shops

As more AI tools become integrated into daily operations, the combination of conversational programming, vision-based alignment, and intelligent G-code optimization will define the next phase of growth for the Indian waterjet cutting community.

Source : 2Do Marketing

G Marketplace & Innovations

Training & Events

- **Expo:** IMTEX , Bangalore 2026 (Jan 21-25, Bangalore)(https://www.imtex.in/)

2Do Corner

Business Development Management (BDM) is a process of developing strategies to enhance the growth and expansion of a company. The BDM team typically focuses on identifying new business opportunities, building and maintaining relationships with clients, and driving revenue growth.

Get in touch with us for your business development management to ensure your company's success !

Click here >> **2Do B**DM

Happy New Year 2026

Call for Collaboration

We're inviting stories, cases, innovations, or partnerships. Want to get featured or co-develop a solution?

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