Apoio:

GEOMETRICAL MODELLING FOR AN AUTOMATED FACETING MACHINE

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GEOMETRICAL MODELLING FOR AN AUTOMATED FACETING MACHINE

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INTRODUCTION

Brazilian Gem Market

- Biggest world-wide concentration of agate, amethyst and citrus;
- Most of Brazilian gems are exported in rude form to be benefited in others countries (USA, China, India);

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Current Situation in Brazil

- Low percentage of country's gems are lapidated
- Lapidated gems are out of internacional standards
- Jewelry industries import calibrated and standardized gems
- Difficulty to compete with asian lapidation industries
- Outdated technology

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Gems and Jewels Technologic Network in RS

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Annual Production of Gross Material in RS

- Amethist: 4.700 ton (Ametista do Sul)
- Agate: 6.470 ton (Salto do Jacuí)
- New fields: Quaraí, etc...

Agate Export in gross: 70%
Amethist Export in gross: 90%

Stone Artefacts Lapidated

- Amethist 10%
- Agate 30%

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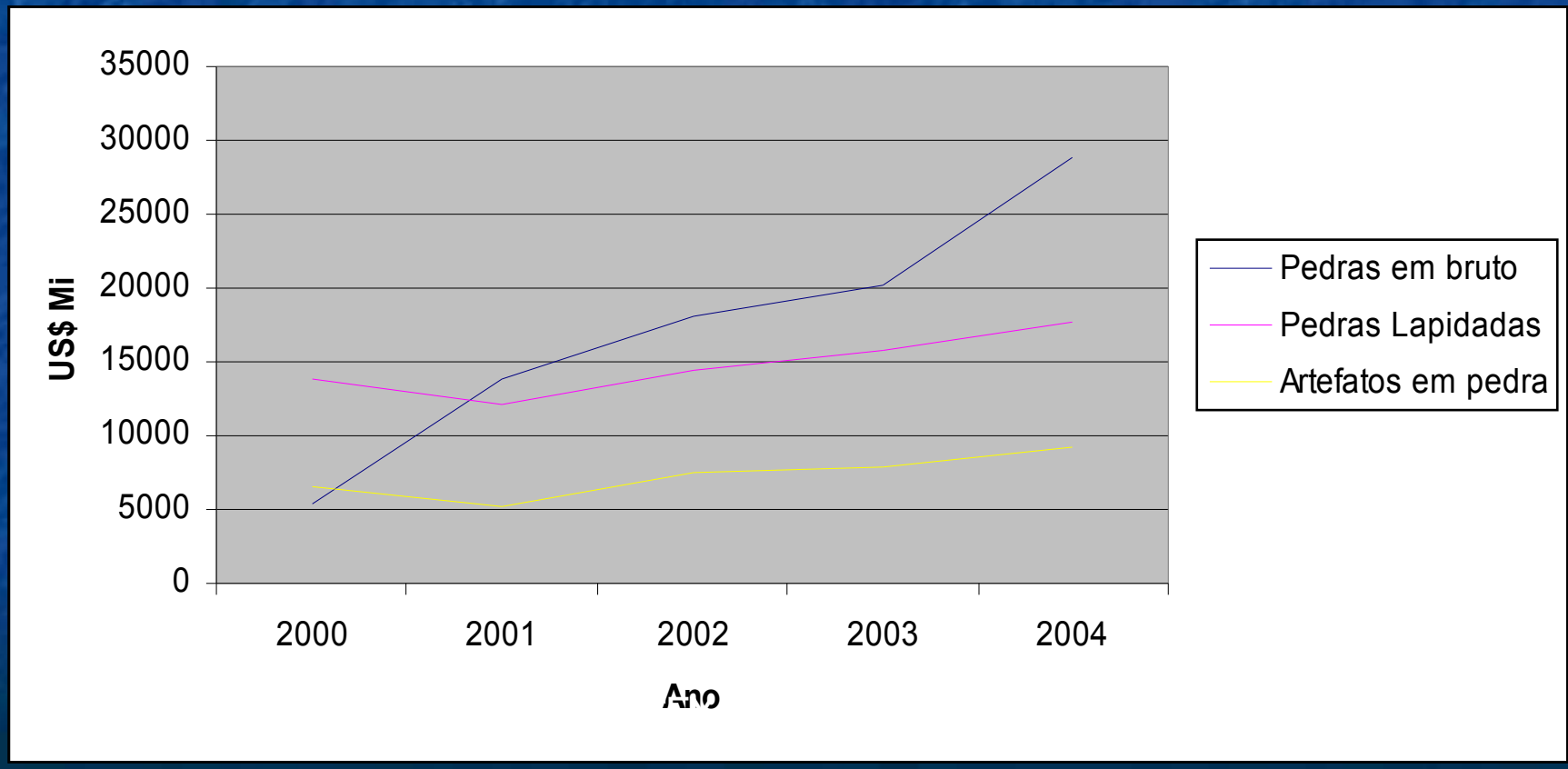
Gem, Jewels and Stone Artifacts Exports from RS



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Competitiveness Parameter

China, september/2004

- **Average salary for a Lapidary: US$200**
- **Lapidation Technology: Lee machines (1950)**
- **Production: 61 stones/day/lapidary**

Source: Geologist Wallid El Koury Daoud

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LAPIDATION TECHNOLOGY DEVELOPMENT

- **Cabuchon Lapidation:**

Technology developed by industry, proven and in proccess of dissemination.

- **Faceted Lapidation:**

Greater complexity → Interaction university-industry.

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Faceted Lapidation

- Brazil uses manual technology
- High dependence on manual hability =
  Lack of standardization in lapidation
  Low volume produced
- Lapidary salary US$ 600 a 800 =
  High production cost

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"Bottleneck" in production

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Automated Lapidation

Advantages:

- Operator independence
- Standardization of pieces
- Less production time
- More complex lapidations

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Less cost = more competitiveness

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Automated Lapidation

Challenges:

- Development of local technology
- Innovative design, patent requered in feb/05
- Multidisciplinary research: mechanics, electric, computing and gemology
- Integration university - industry
- High precision positioning: few μm
- Ruggedness for stone industry environment

FACETING MACHINE CONCEPTION

Main Goal

Perform automatic semiprecious gemstones faceting though the interpretation of a predefined cutting procedure list.

Automatic Faceting Machine for Gems and Jewels

Capability of machine:

- Production capability foreseen:
  160 stones/day/operator
- Internacional parameter:
  61 stones/day/lapidary
- National parameter:
  30 stones/day/lapidary

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Problems Faced:

- Initial positioning of gem in device
- Vibration causing desalignment of gem
- Positioning tolerances
- Uneven wear of discs
- Adecuation to different gems hardness
- Gem transfer for faceting other side

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Advantages:

- Add value (US$) and quality to designed Brazilian gems;
- Provide Brazilian competitiveness with the biggest global gemstones industries;
- Initial positioning of gem in device

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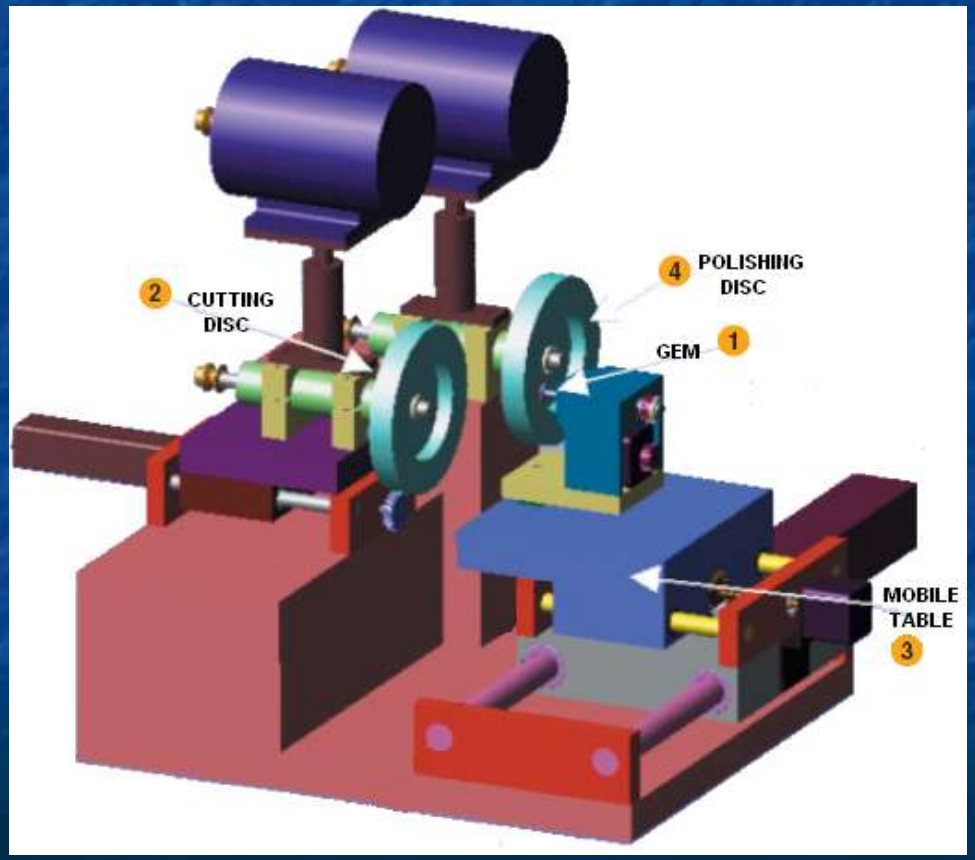
MACHINE OPERATION



- **Cutting Disc:** Produce plan cuts in the gem surface;
- **Disc:** Responsable to produce brightness to the gem;
- **Mobile Table:** Perform all necessary movimentation steps of gem facetting.

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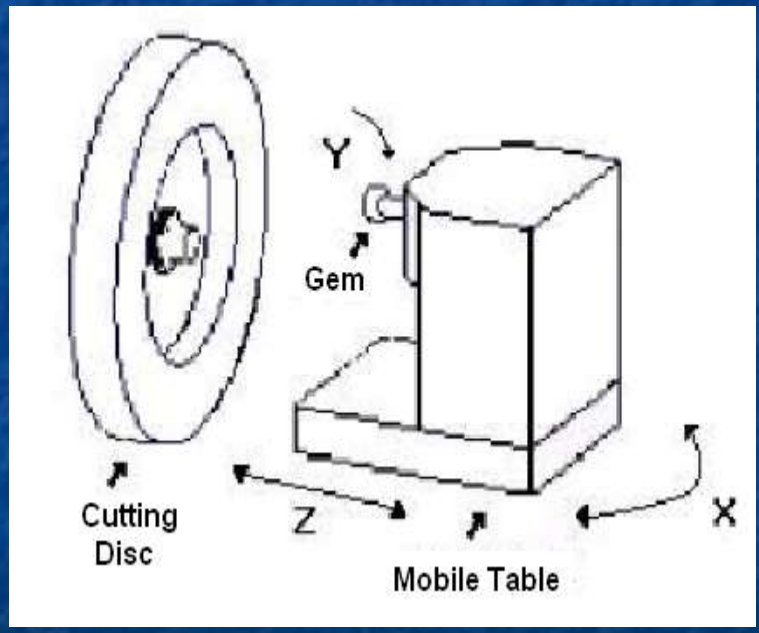
Movimentation

- Control of three independent motors allows linear and angular movimentation;
- **1st Motor (X axis):** control rotation of the mobile table;
- **2nd Motor (Y axis):** control rotation angle of the gem;
- **3rd Motor (Z axis):** control distance between gem and the current disc;



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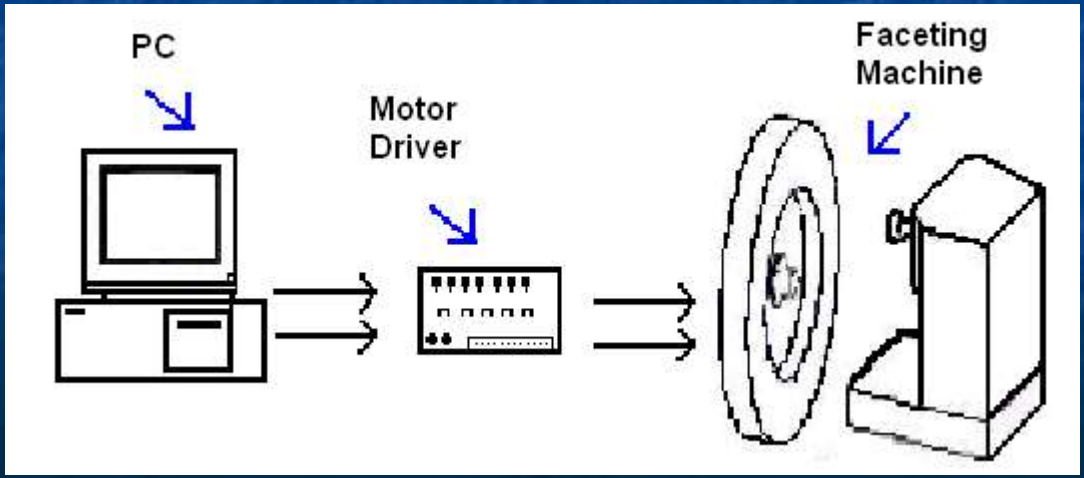
Programming

- **CNC Tools:** G language (G code)
- **Specific Software:** List of procedures describes sequence of moviments to be implement in each axis



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Characteristics

- **Resolution:** 1,8º;
- **Repetibilility:** aproximately 100%;
- **Temporal behavior:** deterministic;

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GEOMETRICAL MODELLING

- **Software built in C language;**

- **List of steps containing:**
  - Corresponding axies: X, Y or Z;
  - Kind of Motion: linear or angular;
  - Displacement: cm or degrees;

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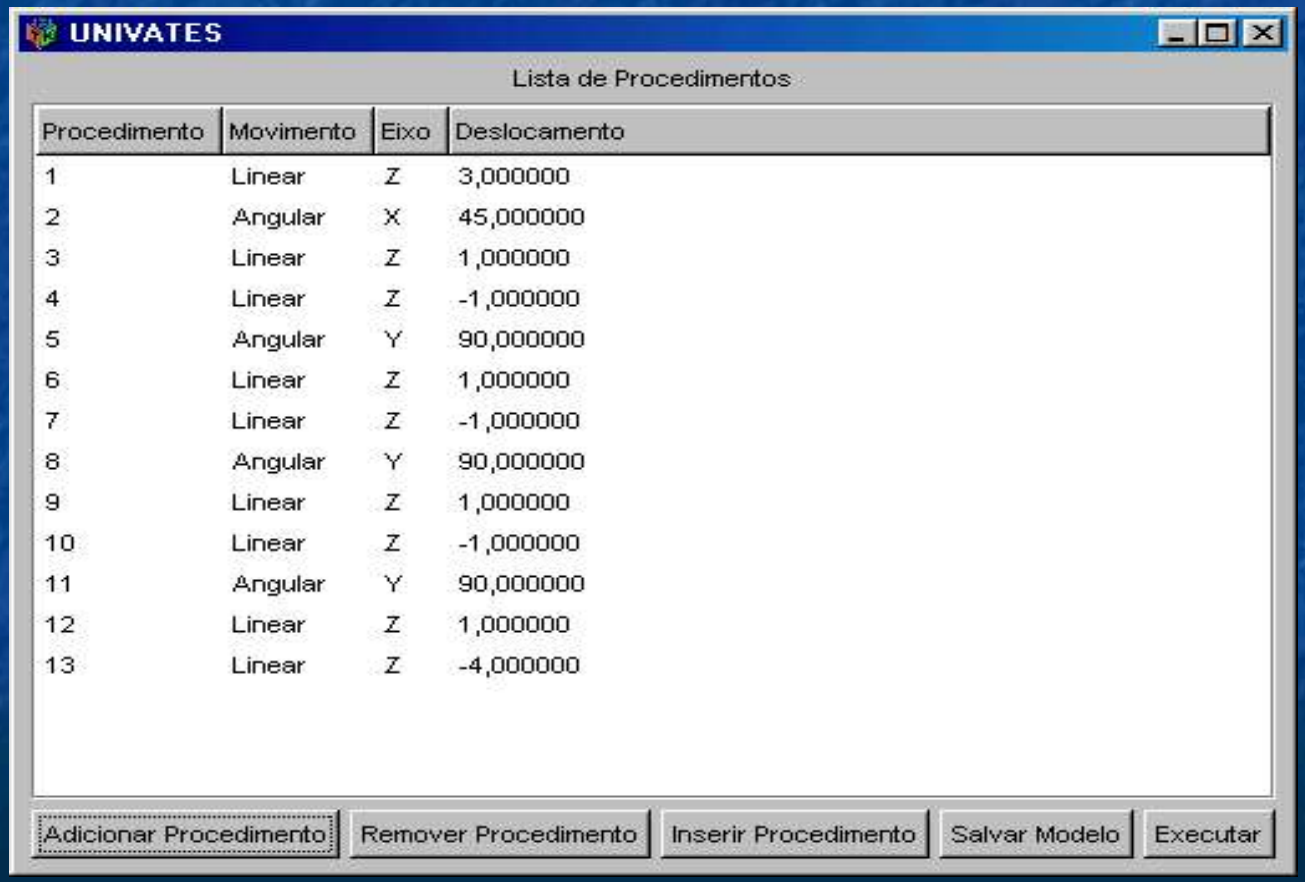
Example for 4 Facetes of 90° with approach angle of 45° (video attached)



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Automated Faceting Machine for Gems and Jewels

Current status:

- 2nd prototype under tests
- Software in final stage
- Geometrical modelling not practice
- Series production in planning
- Forecast for conclusion: may 2006

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