About Product and Service

**Metal spinning** is a plastic forming process that forms a metal sheet or tube by forcing the metal onto a rotating mandrel using a roller tool. It is widely used for making round hollow metal products. AIST has been studying metal spinning applying robot technologies such as sensory feedback control, with the aim to develop versatile and intelligent forming processes. In particular, AIST is conducting R&D on metal spinning of non-axisymmetric shapes. Products of metal spinning have been inherently limited to axisymmetric shapes that have circular cross sections around the rotation axis. Nonetheless, there is a potential demand for non-axisymmetric products formed by metal spinning which have e.g. elliptic, polygonal and eccentric cross sections. Metal spinning will be used more widely if it can produce a variety of non-axisymmetric products.

**Technology**

AIST has developed two metal spinning methods to form non-axisymmetric products, i.e., **Force-controlled Metal Spinning** and **Synchronized Metal Spinning**.

In force-controlled metal spinning, a non-axisymmetric mandrel of a desired shape is used. The pushing force of the forming roller is controlled to a constant value based on feedback signal from the force sensor so that the material is forced onto the mandrel. Meanwhile the forming roller is position-controlled in a constant velocity in the feeding direction parallel to the mandrel axis. The roller follows the contour of the mandrel to fit the material to the mandrel. Then a non-axisymmetric product of the same shape as the mandrel is fabricated.

While a non-axisymmetric product is being spun, the roller should move forward and backward very rapidly. AIST has developed a novel metal spinning machine in which the roller is directly driven by linear motors. The roller can quickly track the contour of the mandrel and the forming time of non-axisymmetric products is significantly reduced.
Another method to form non-axisymmetric products is synchronized metal spinning. The radial displacement $x$ of the roller is controlled synchronizing with the rotation angle $\theta$ of the work. Trajectory of the contact point between the roller and the work makes the desired cross-section shape. This method is especially effective in forming non-axisymmetric tubes since no mandrel is necessary.

Synchronized Metal Spinning

**Application**
- aluminum, steel, stainless steel and other metals
- various industries such as automotive, aerospace, electronics, medical, lighting, architectural etc.
- suitable for small production lot with a variety of design, prototyping and product development because of low tooling cost and short turnaround

**Technology Transfer**
Sample parts and video CDs are available on request. AIST plans to develop a commercial metal spinning machine for non-axisymmetric shapes in collaboration with Daito Spinning Co., Japan.

**Patents**
- USP7,131,304: Spinning method and apparatus (patent pending in Germany and Japan)
- PCT/JP2004/017869

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