

Automated testing for print inspection systems

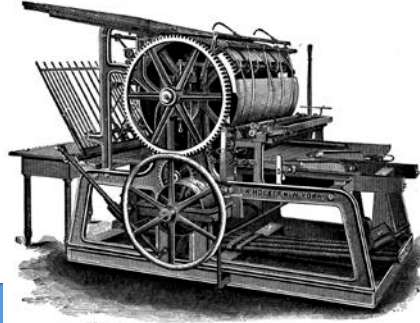
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Bernhard.Blaschitz@ait.ac.at

AIT Austrian Institute of Technology GmbH
Intelligent Vision Systems
Vienna, Austria
www.ait.ac.at

Systematic overview of print inspection system



Generate print patterns



Printing

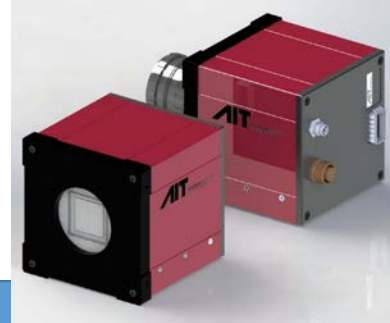


Image acquisition

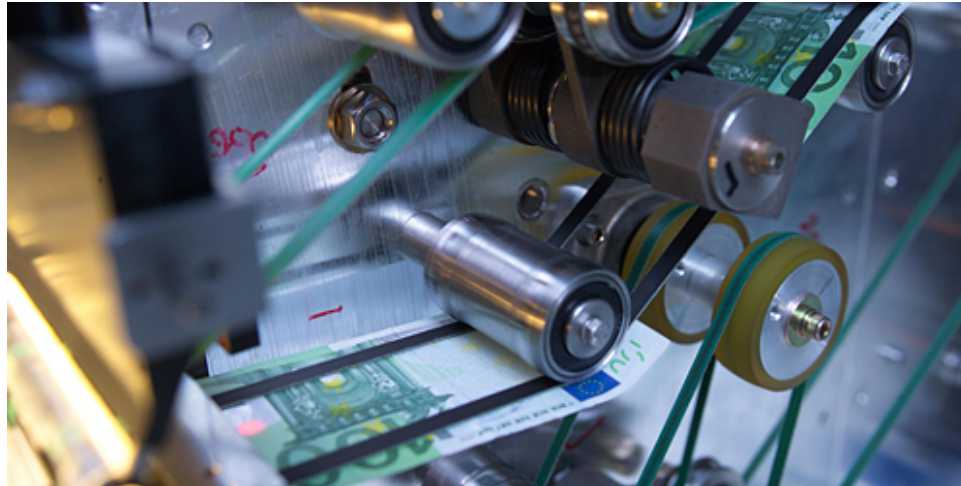
```
public class TcpClientSample
{
    public static void Main()
    {
        byte[] data = new byte[1024]; string input, stringData;
        TcpClient server;
        try{
            server = new TcpClient("...", port);
        } catch (SocketException) {
            Console.WriteLine("Unable to connect to server");
            return;
        }
        NetworkStream ns = server.GetStream();
        int recv = ns.Read(data, 0, data.Length);
        stringData = Encoding.ASCII.GetString(data, 0, recv);
        Console.WriteLine(stringData);
        while (true) {
            input = Console.ReadLine();
            if (input == "exit") break;
            newchild.Properties["id"].Add("Auditing Department");
            if (input == "CommitChanges") {
                newchild.Close();
            }
        }
    }
}
```

Print checking algorithms

Paper,
Printing,
Printing Defects

Transport,
Illumination,
Optics,
Camera

Aims



- **to continuously improve our existing print inspection systems**
- to estimate the behaviour of a real print inspection system if certain components (e.g. camera, lens, transport) or algorithms are exchanged.
- to quantify the detection probability of defined printing defects.

**→ Simulate (parts of)
the System**

Verification

Was the spec correctly implemented? (Bugs)

vs.

Validation

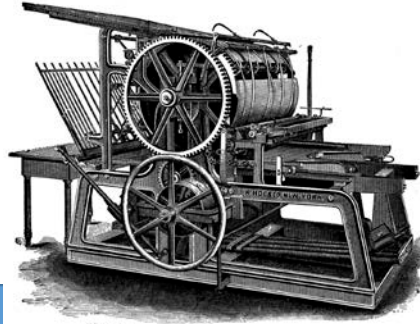
Is the algorithm robust w.r.t. difficult input?

→ Test datasets

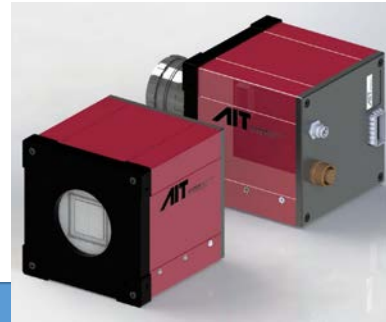
Systematic overview of the validation



Generate print patterns



Simulate paper and printing



Simulate image acquisition

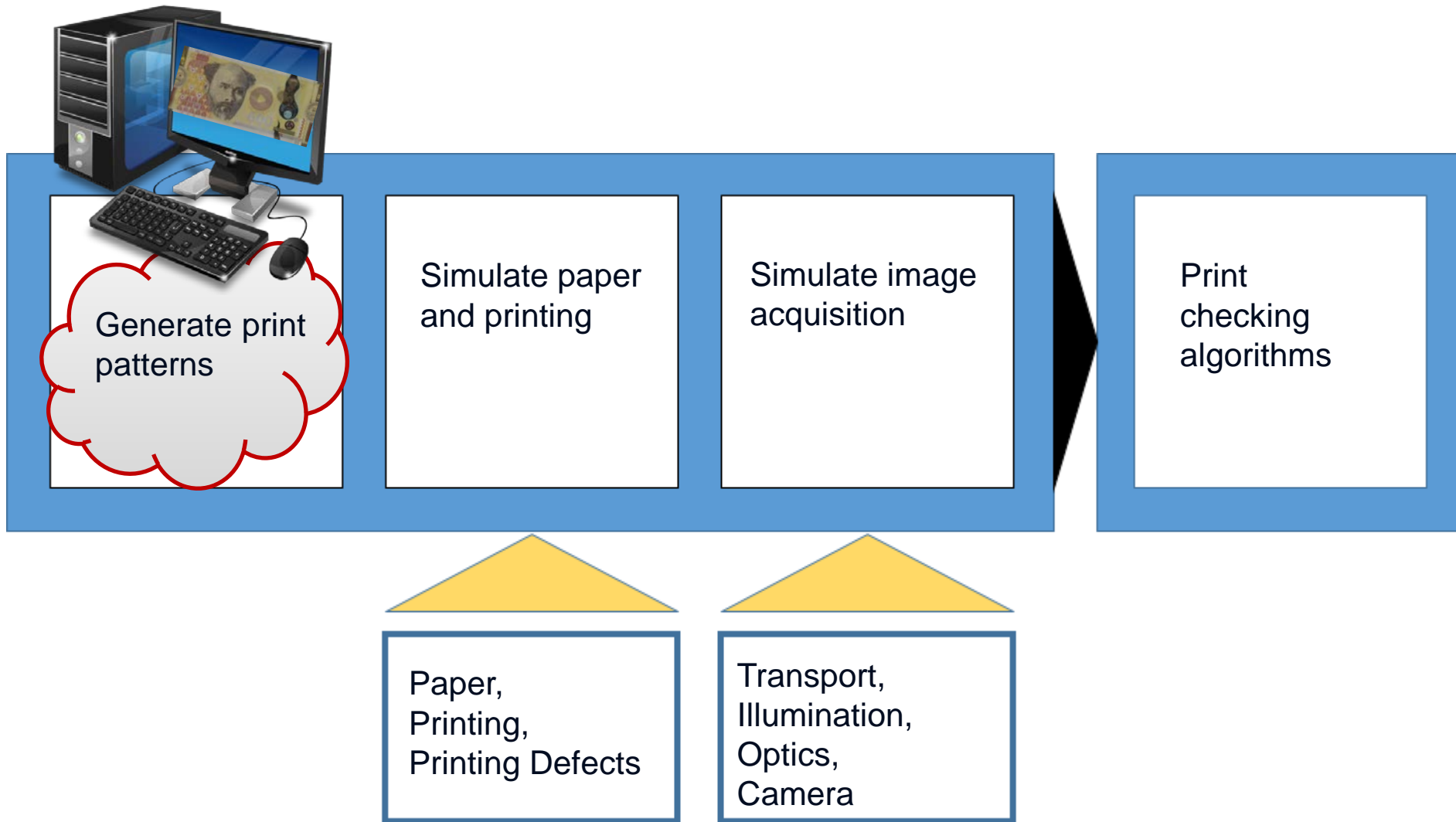
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    public static void Main()
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        TcpClient server;
        try{
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        } catch (SocketException) {
            Console.WriteLine("Unable to connect to server");
            return;
        }
        NetworkStream ns = server.GetStream();
        int recv = ns.Read(data, 0, data.Length);
        stringData = Encoding.ASCII.GetString(data, 0, recv);
        Console.WriteLine(stringData);
        while (true) {
            input = Console.ReadLine();
            if (input == "exit") break;
            newchild.Properties["id"].Add("Auditing Department");
            if (input != null) {
                newchild.Close();
            }
        }
    }
}
```

Print checking algorithms

Paper,
Printing,
Printing Defects

Transport,
Illumination,
Optics,
Camera

Systematic overview of the validation



Test Data Generation

Simulating Banknote Paper and Printing

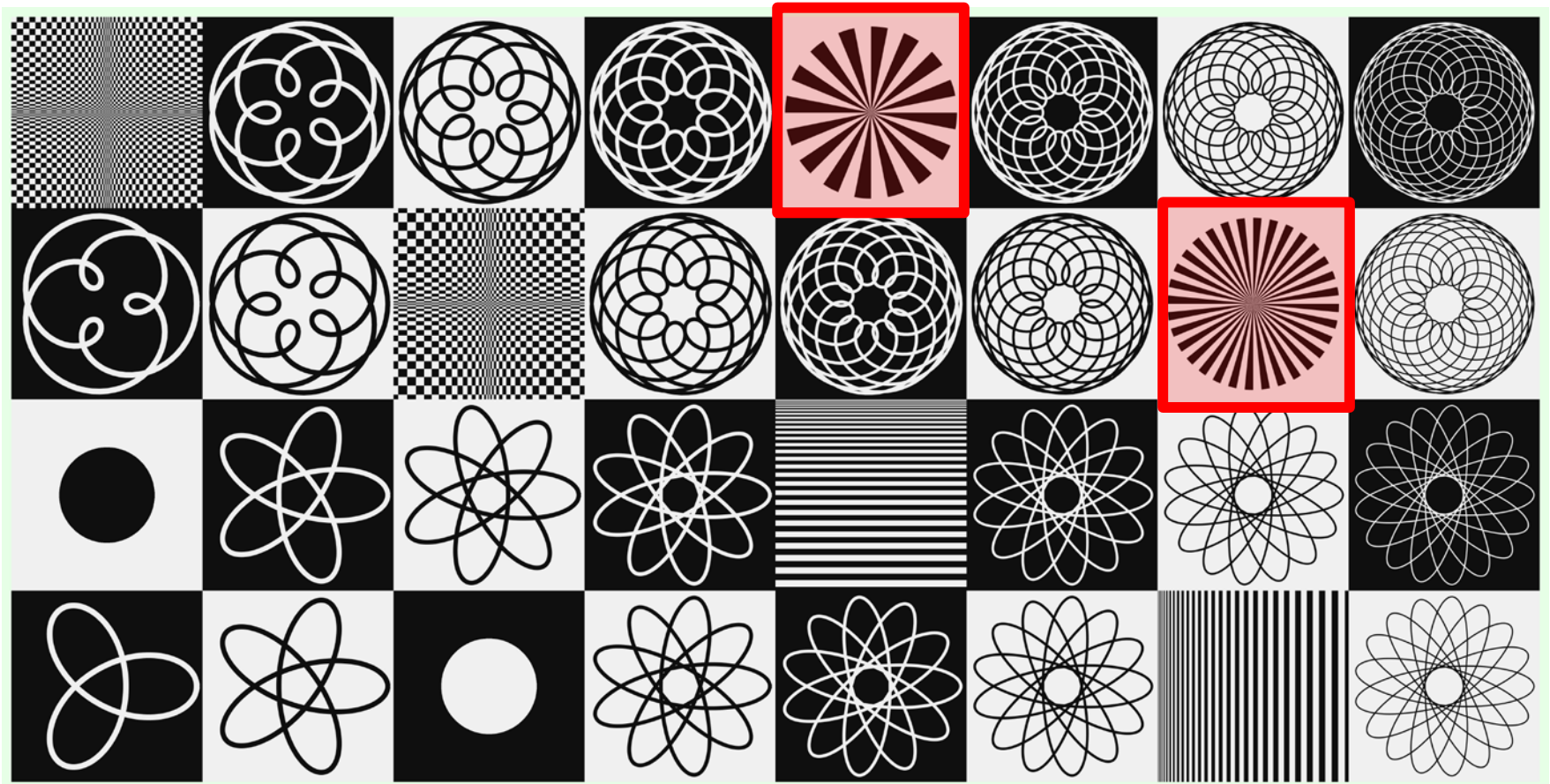


We thank Oesterreichische Banknoten und Sicherheitsdruckerei (OeBS) for providing the demo banknotes.

Test Data Generation

Test Pattern version 1

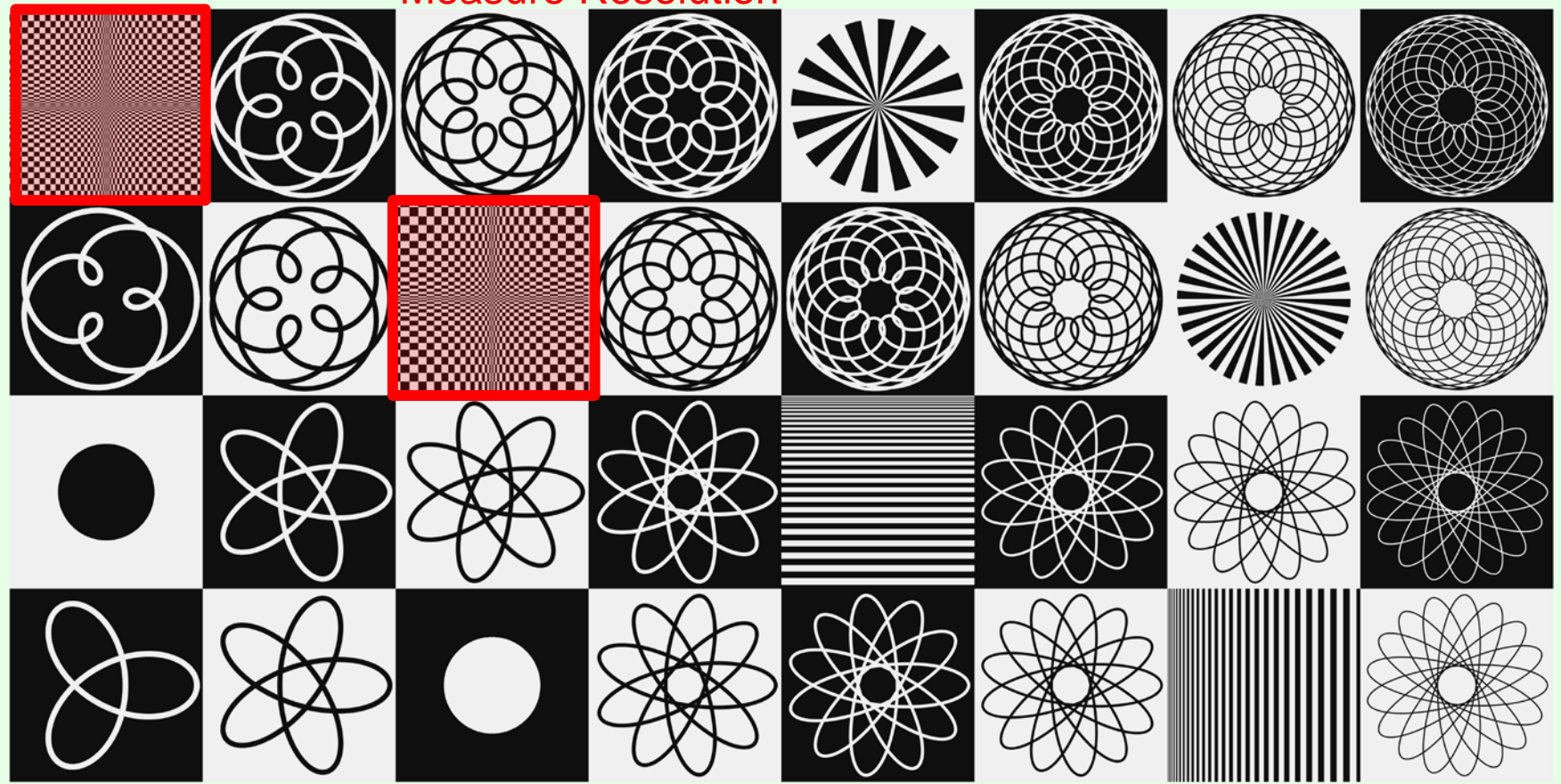
Siemens Star



Test Data Generation

Pattern Generation

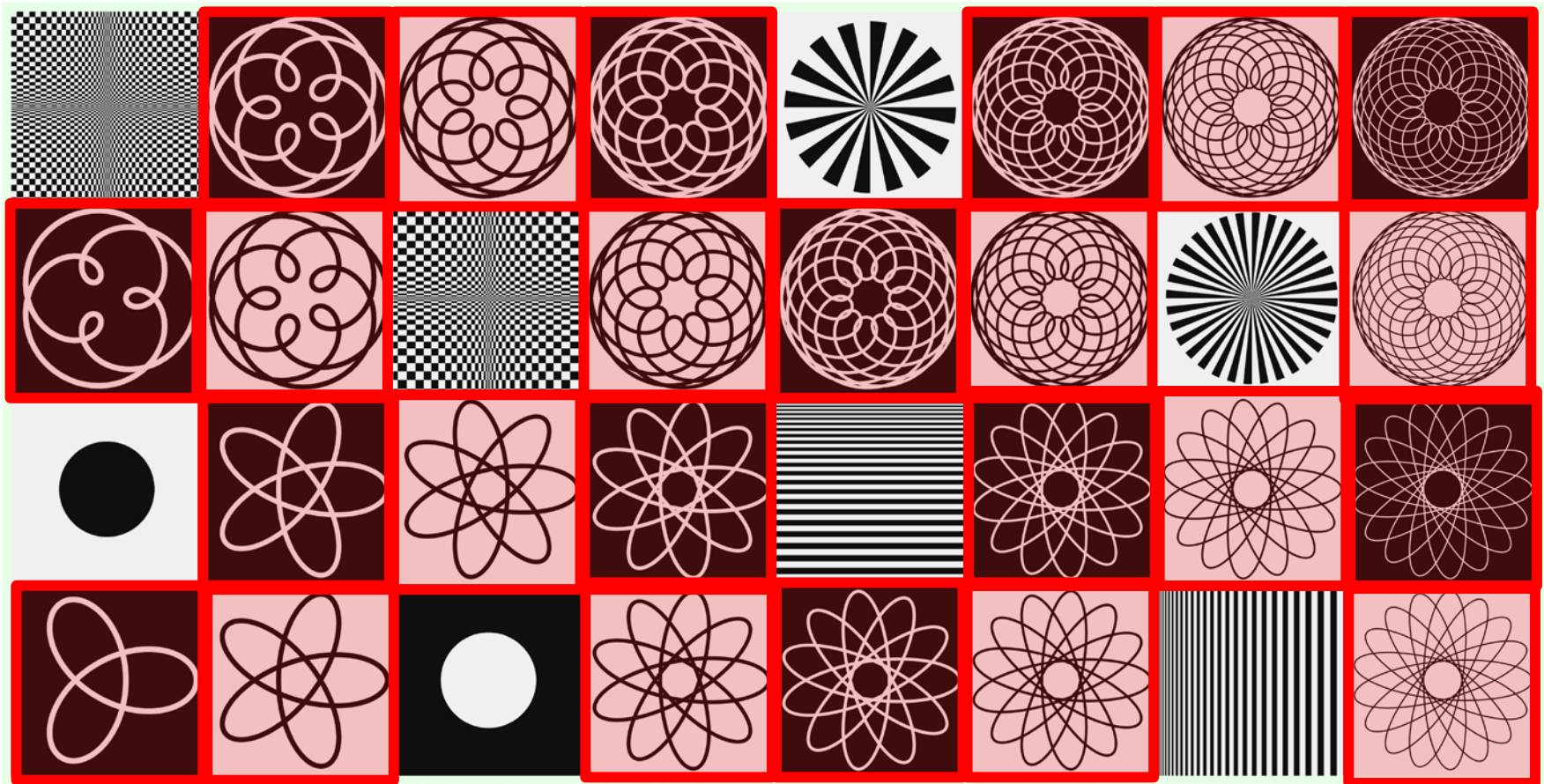
Measure Resolution



Test Data Generation

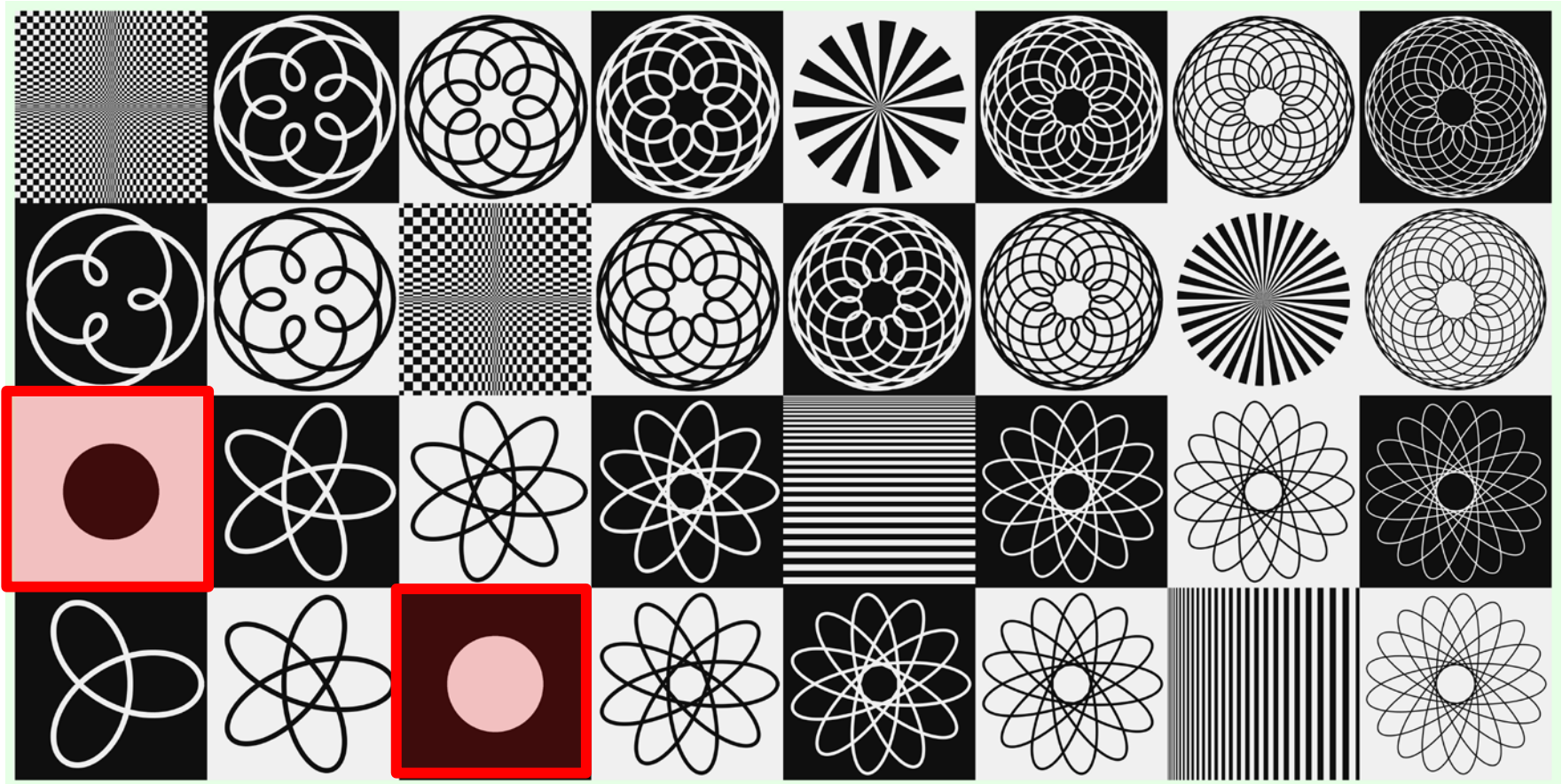
Pattern Generation

Guilloché like epicycles



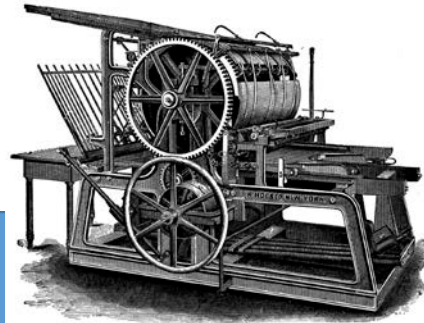
Test Data Generation

Pattern Generation



Sharpness check for edges independent of direction

Systematic overview of the validation



Generate print patterns

Simulate paper and printing

Simulate image acquisition

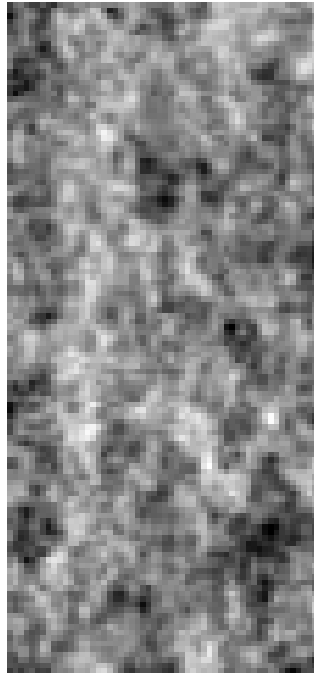
Print checking algorithms

Paper,
Printing,
Printing Defects

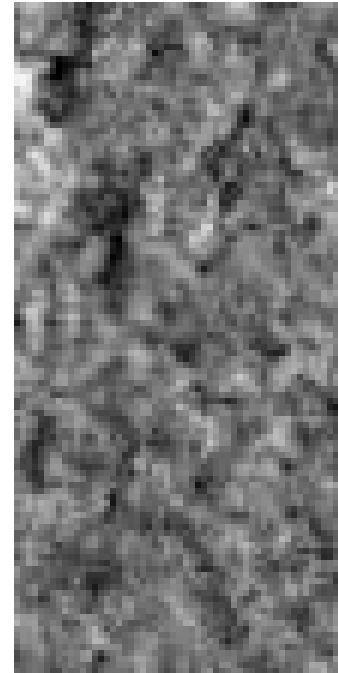
Transport,
Illumination,
Optics,
Camera

Test Data Generation

Paper Cloudiness



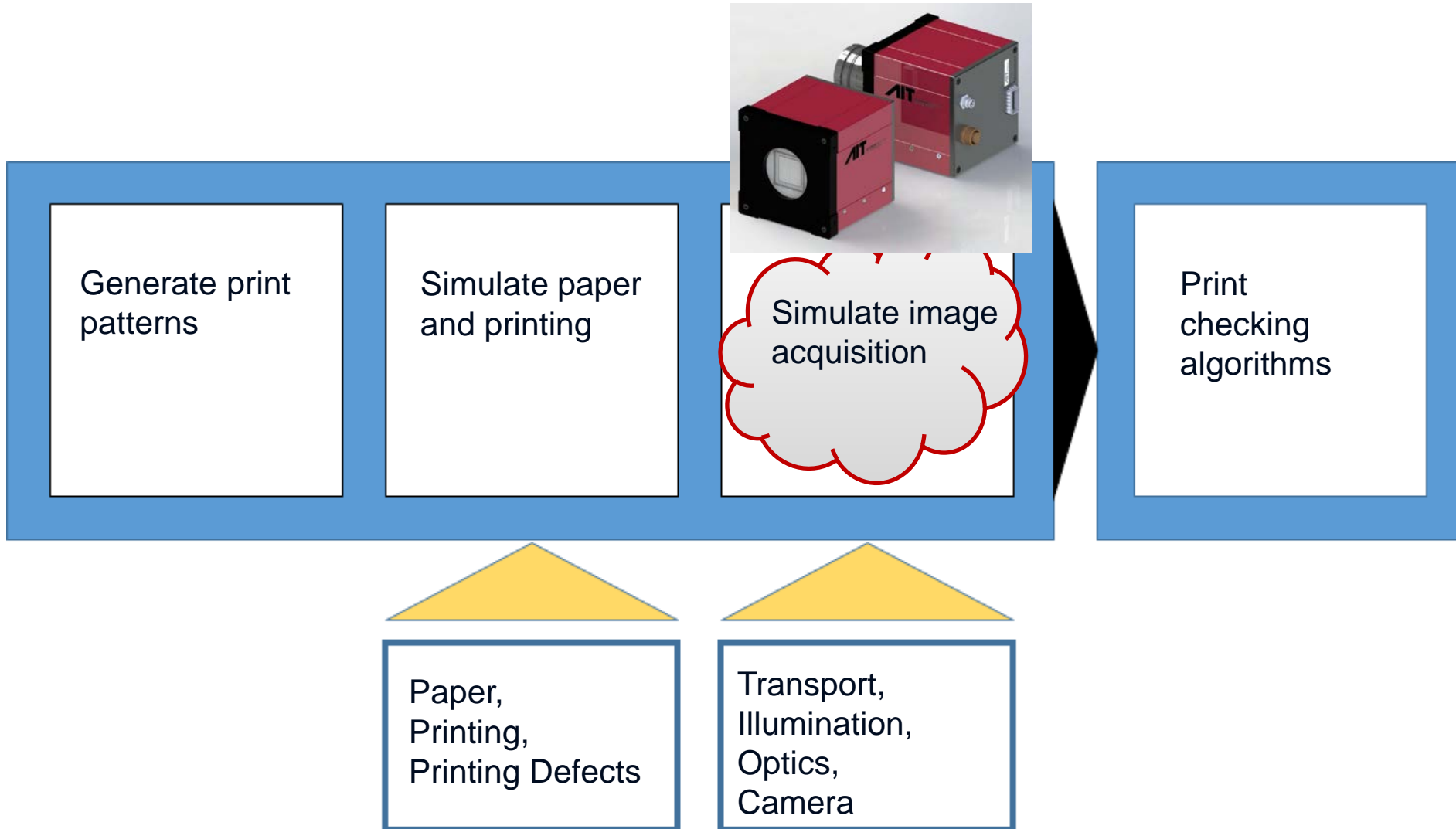
Original Paper



Simulated Paper

Source: Alexei A Efros and Thomas K Leung, 'Texture synthesis by nonparametric sampling', in Proc. ICCV, volume 2, pp. 1033–1038. IEEE,(1999).

Systematic overview of the validation

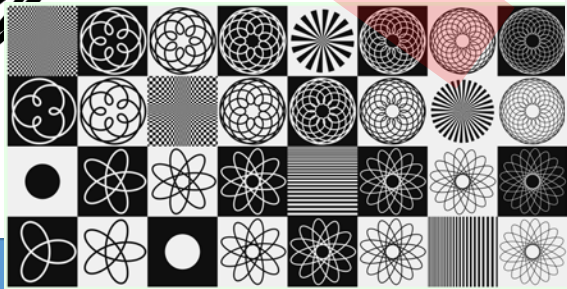
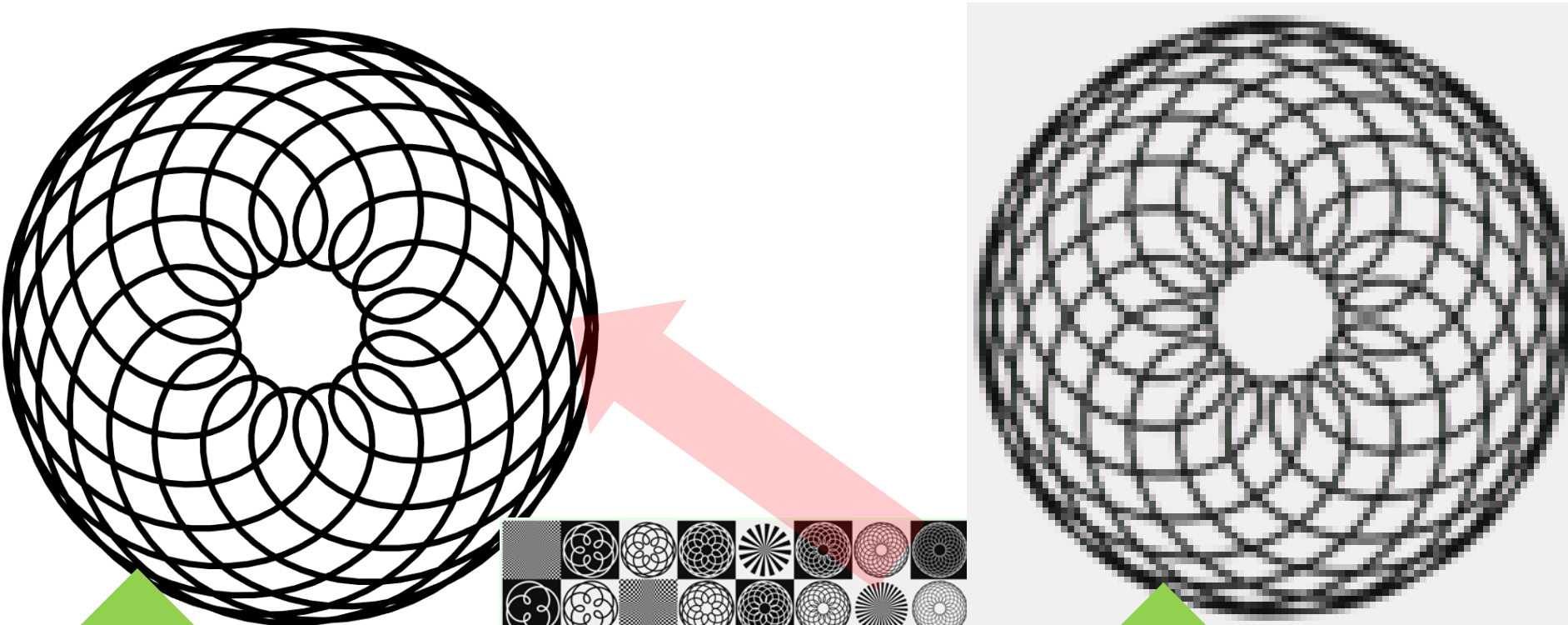


Test Data Generation

Simulating Image Acquisition through Slanted Edge Method



Source: Peter D. Burns, 'Slanted-edge MTF for digital camera and scanner analysis.', in Proc. of PICS, pp. 135–138. IS&T, (2000).

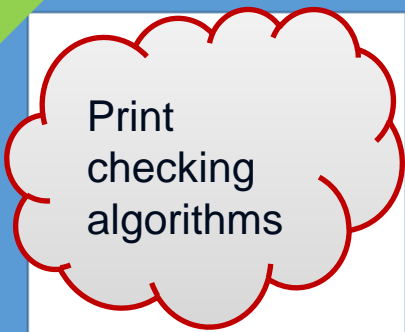


Generate print patterns

Simulate paper and printing

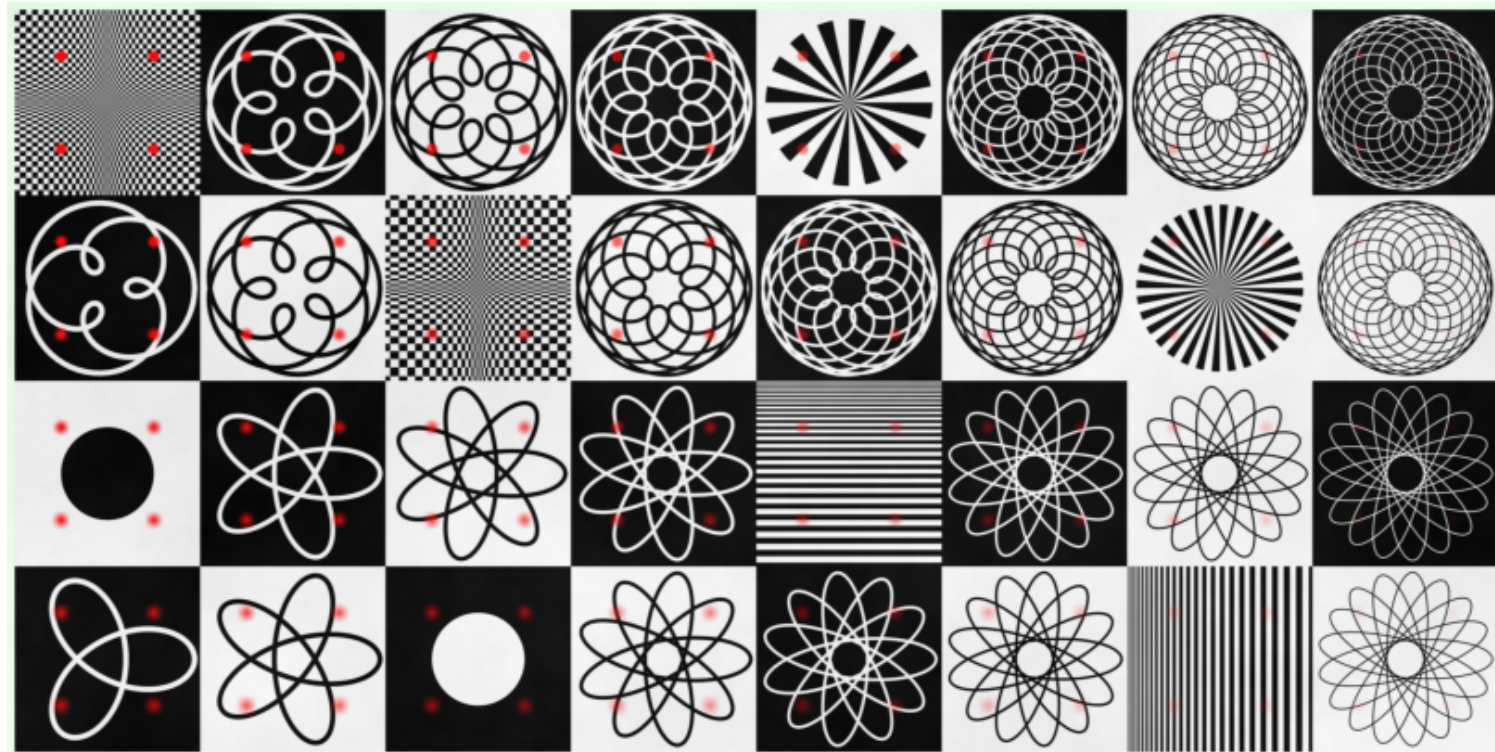
Simulate image acquisition

Print checking algorithms



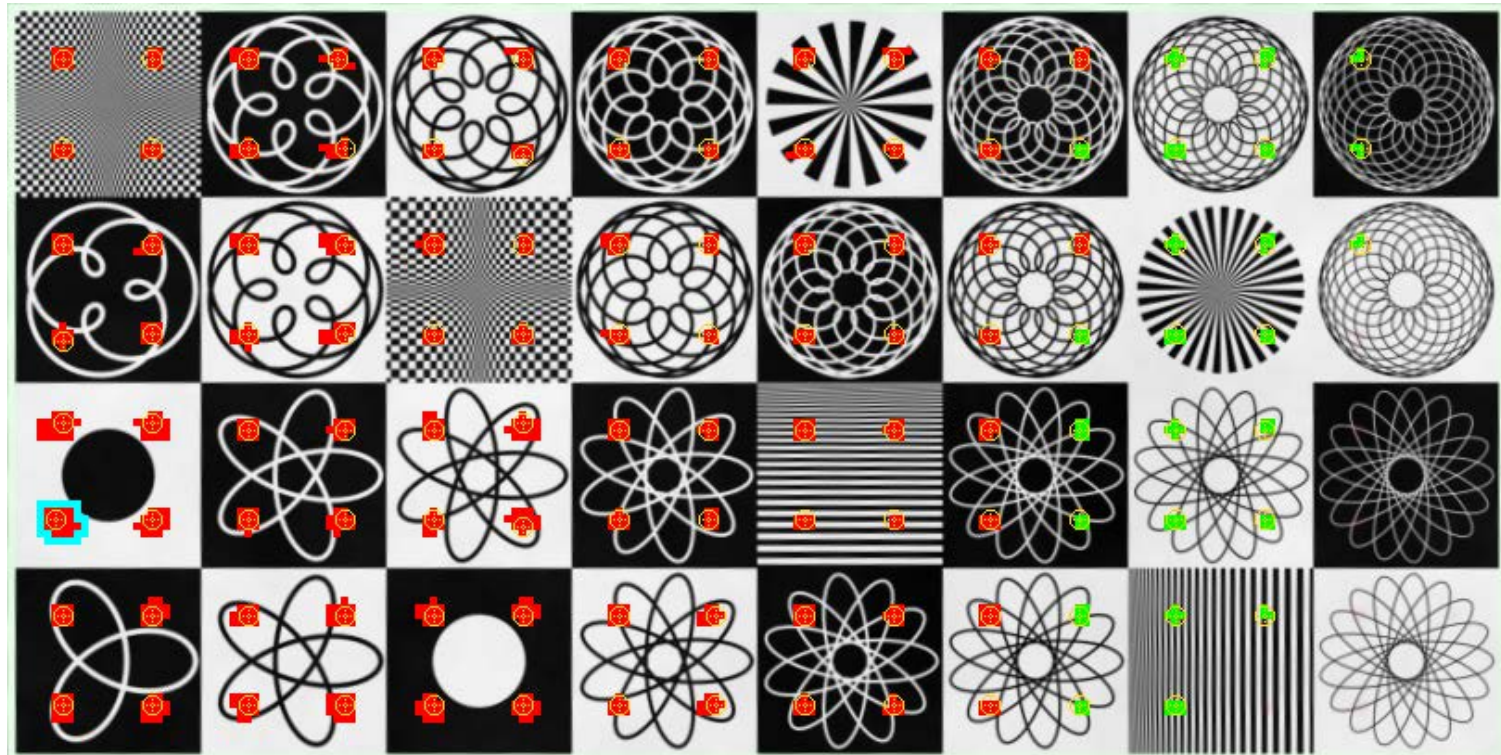
Testing the Print Inspection System

Evaluating the System with Synthetic Data

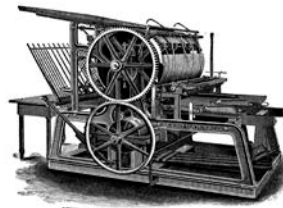


Testing the Print Inspection System

Evaluating the System with Synthetic Data



How to continuously improve an existing print inspection system



```

public class TopClientExample
{
    public static void Main()
    {
        byte[] data = new byte[1024];
        TopClient client = new TopClient("localhost", 8080);
        client.Connect();
        client.Send("GET / HTTP/1.1\r\n\r\n");
        client.Receive();
        Console.WriteLine("Received: " + client.Receive());
    }
}

```

Generate print patterns ✓

Simulate Paper and Printing ✓

Simulate Image acquisition ✓

Print checking algorithms ✓

AIT Austrian Institute of Technology

your ingenious partner

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