



A Real-Coded Genetic Algorithm for the Determination of Liquids Refraction Index

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Motivation

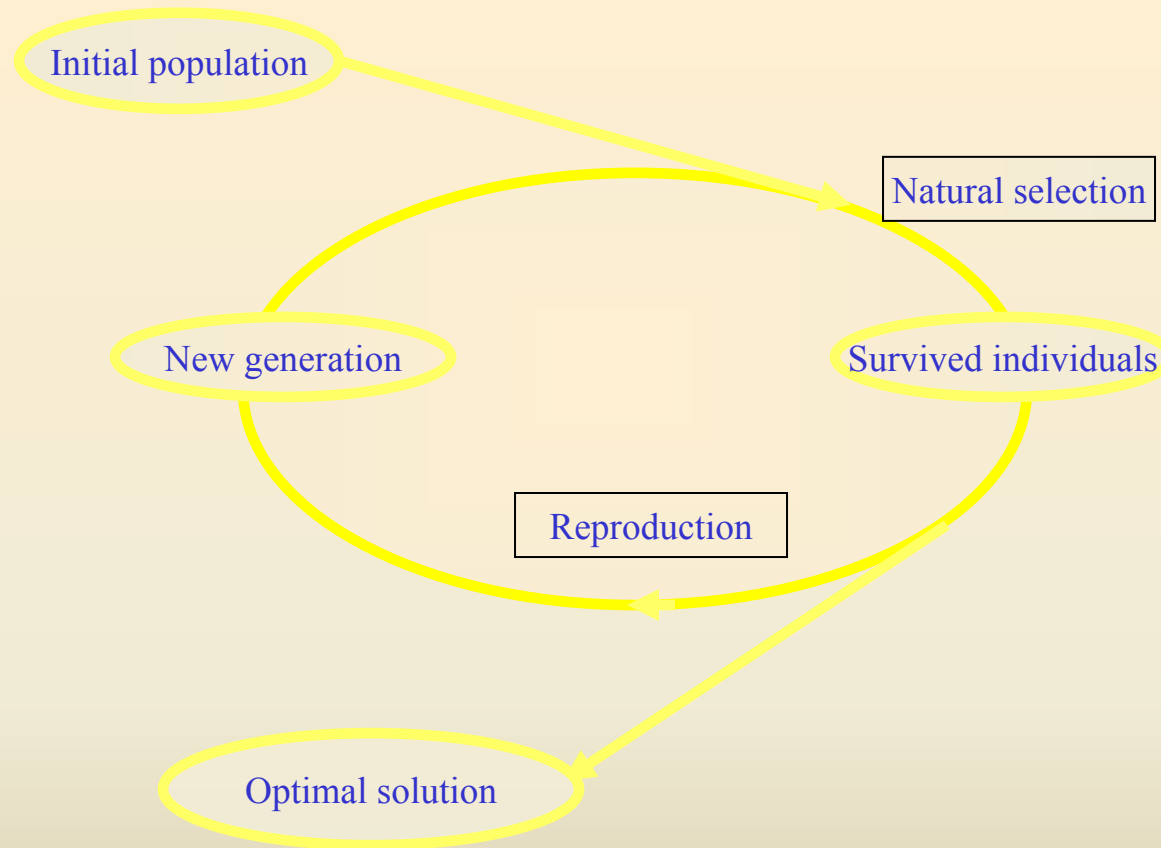
- Improvement of double exposure holographic method to analyze optical fibers
- Determination of liquids refraction indices



Outline

- Introduction
- Holographic interferometry
- Solution
 - Computer processing and data acquisition
 - Implementation of GA
- Results and discussion
- Conclusions

Introduction

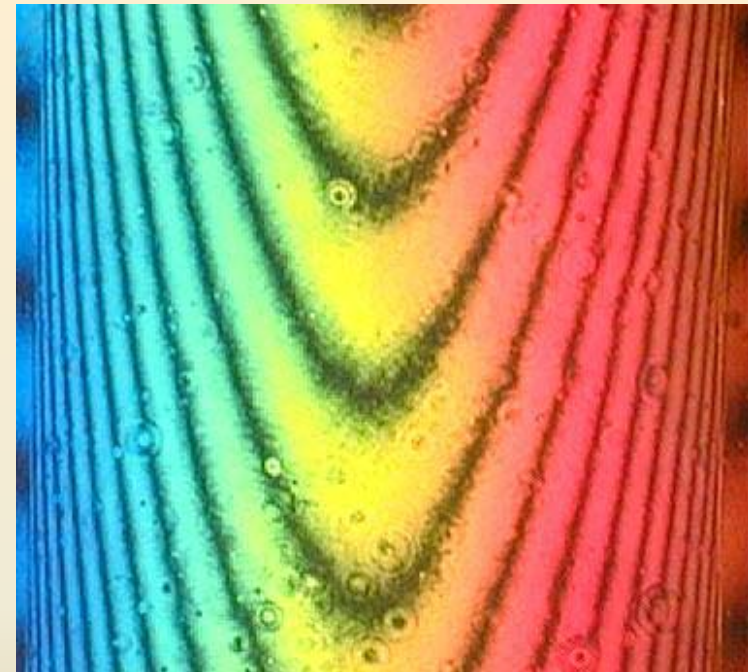
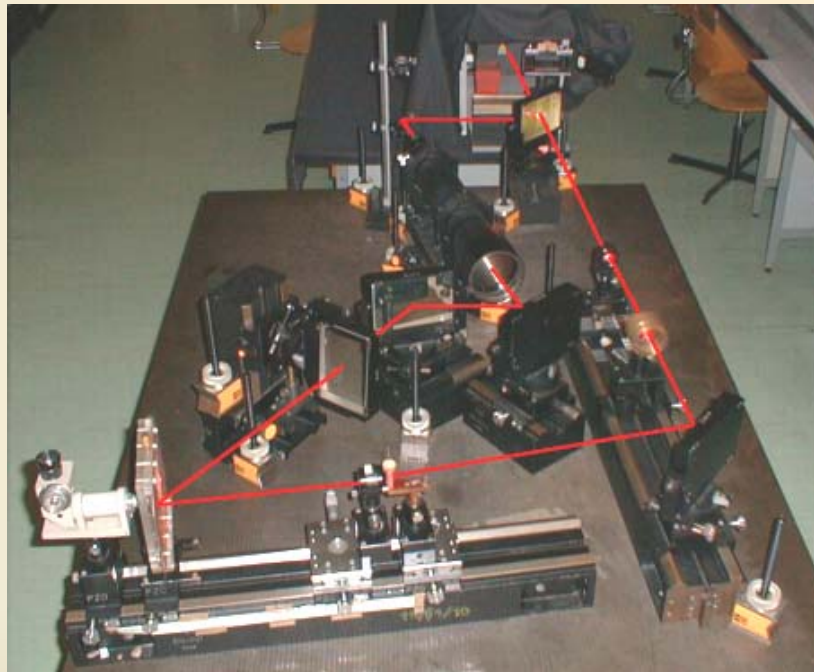




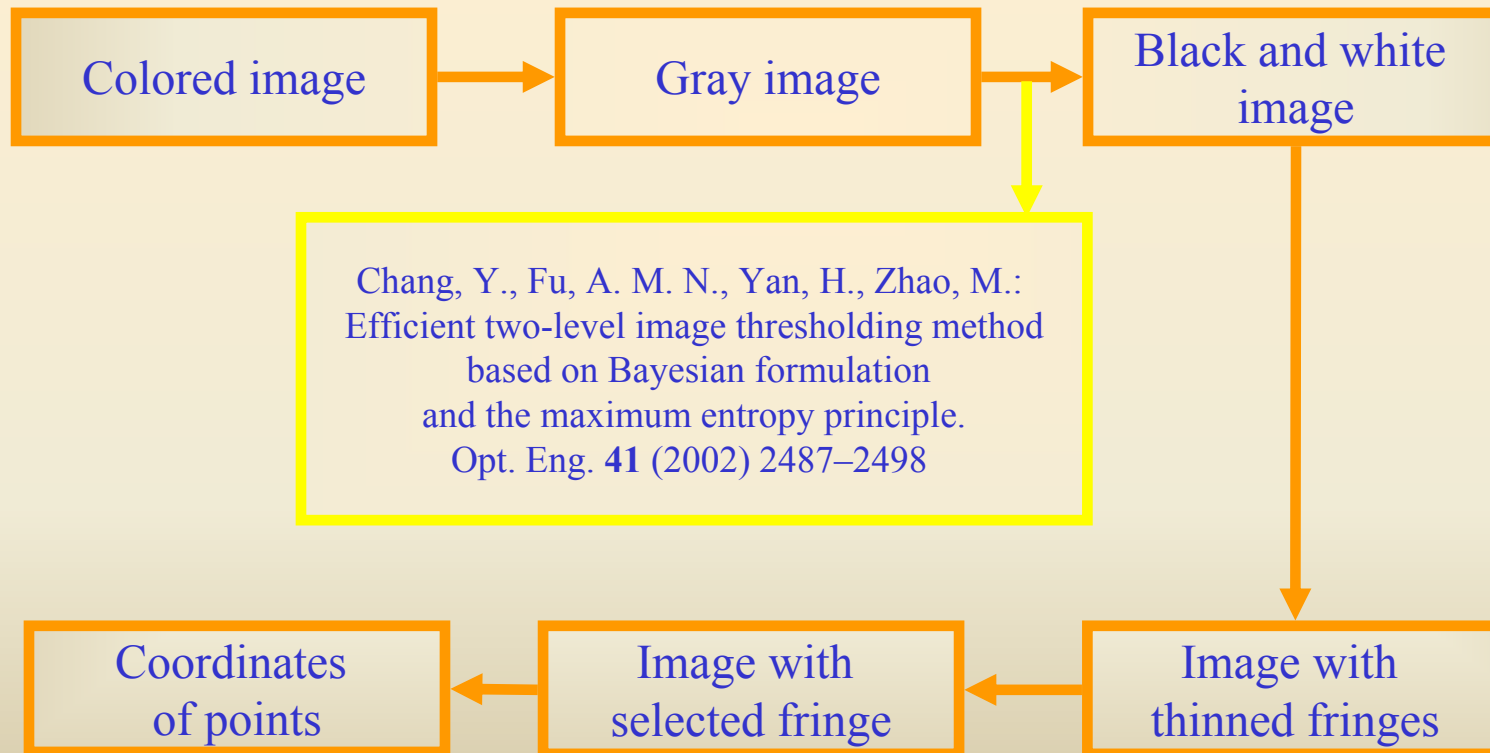
A (D)evolutionary Algorithm! :o)

A Tutorial on Genetic Algorithms, Mohammad Akbarzadeh

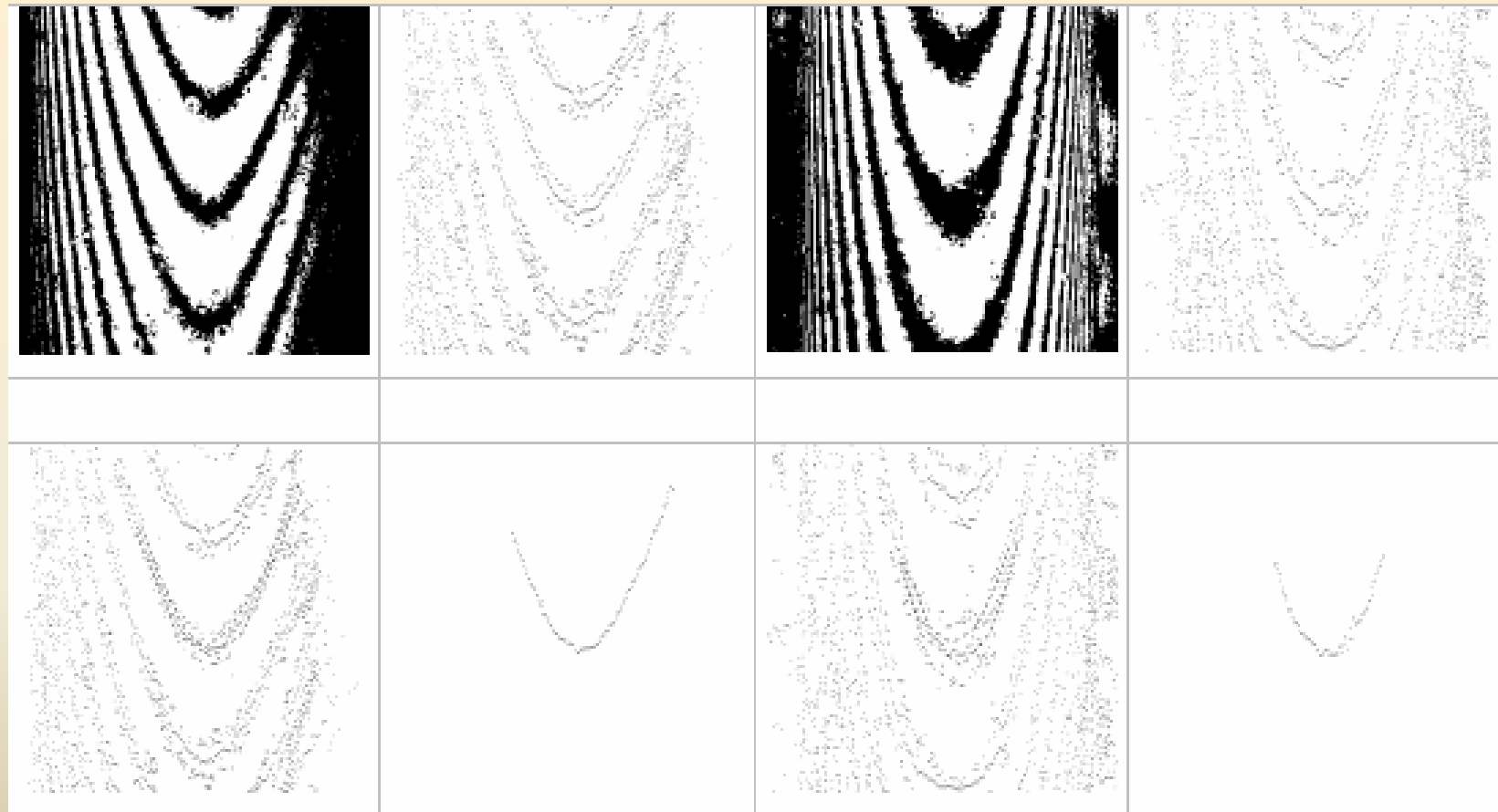
Holographic interferometry



Computer processing and data acquisition (1/2)



Computer processing and data acquisition (2/2)



Implementation of GA (1/4)

- Genome: y_0 and n_G
- Evaluation function:

$$M : (y_0, n_2) \rightarrow \sum_{i=1}^n |y_i - f(x_i)|^2$$

- used instead of fitness function
- saved also in genome



Implementation of GA (2/4)

- number of generations: 20
- number of genomes in the population: 20,000
- number of genomes allowed to reproduce: 2,000
- the crossover probability: 0.5
- the mutation probability: 0.2.



Implementation of GA (3/4)

```
procedure Mate(MateProbability: Double; var Mother, Father:
TGenome); StdCall;
var
  New1, New2: TGenome;
  r: Double;
begin
  r := MateProbability;
  New1.n0 := r * Mother.n0 + (1 - r) * Father.n0;
  New1.y0 := r * Mother.y0 + (1 - r) * Father.y0;
  New2.n0 := (1 - r) * Mother.n0 + r * Father.n0;
  New2.y0 := (1 - r) * Mother.y0 + r * Father.y0;
  Mother := New1;
  Father := New2;
end;
```



Implementation of GA (4/4)

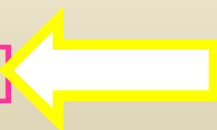
```
function Mutate(Any: TGenome; MutProb: Double; n1:
Double): TGenome;
begin
  Result := Any;
  if Random < MutProb then
  begin
    Result.y0 := (Random(2000) - 1000) / 10;
    Result.n0 := n1 - (Random -0.5)* 0.2;
  end;
end;
```

Results and discussion

Parameters	#1	#2
x_0 [pix]	181	152
b [pix.]	178	138
a [pix]	160.2	124.2
h [pix.]	103	156
b [mm]	0,825	0,55
n_1	1.45718	1.45718
n_2	1.44048	1.44048

#	#1	#2
1	1.45464	1.45474
2	1.45470	1.45472
3	1.45474	1.45475
4	1.45471	1.45473
5	1.45471	1.45478
6	1.45466	1.45477
7	1.45466	1.45476
8	1.45468	1.45477
9	1.45467	1.45478
10	1.45466	1.45469
Average value	1.45468	1.45476
Standard uncertainty	$3 \cdot 10^{-5}$	$2 \cdot 10^{-5}$

[1.45471; 1.45475]





Conclusions

- Advantage:
 - measurement of immerse liquids refractive index value without replacement of the cuvette
- Disadvantage:
 - the value of immerse liquid refraction index must be approximately the same as the value of fiber cladding core



Future work

Magneto-optical visualization of magnetic fields
of HTSC

Thank you for your attention.