Fast Auto-Focus

Must-have technology for next generation digital cameras

Background

- Consumers desire high quality photos with as little effort as possible.
- Perception of “quality” depends in large part on image sharpness and speed of image capture
- Both depend on auto-focus implementation
  - Current state-of-the -art is believed to be proprietary forms of Modified Rule-Based Search (MRS) approach

Fast Auto-Focus Technology

- Technology Summary
  - Only known mathematical approach to systematically and quickly determine optimal set of passive auto-focus parameters for any camera that uses contrast sensing auto-focus
- Value proposition
  - Fast Auto-Focus results in superior auto focus performance compared to known state-of-the-art
    - Speed
    - Accuracy
    - Power consumption
    - User experience
  - Significant gain in performance time anticipated on *any* compatible camera platform
  - Performance verified in three representative camera platforms

Two-Part Approach

- Novel process for automatically deriving a set of optimal passive AF parameters from camera specifications
  - Implemented during camera design process
- New passive AF search algorithm which uses the derived parameters and a novel methodology
  - Implemented during image capture

- Result: Number of iterations is reduced

⇒ Lowers auto-focus time, without compromising image quality

Performance Tests–Description

- Basis of Comparison
  - Global Search (GS) (ground truth)
    - Scan every position in search domain
  - Modified Rule-Based Search (MRS) (state of the art)
    - Best known improvement over Global Search
  - Fast Search (FS)
    - Approach used in Fast Auto-Focus Technology
- Demonstration Platforms

No.	Type	Focus Actuator	Image Sensor	Opt. Zoom
1	DSC (low end)	Stepper Motor	3 MPix CCD	3x
2	DSC (high end)	Stepper Motor	10 MPix CCD	3x
3	Camera-Phone	Voice-coil	5 Mpix CMOS	N/A

Performance Demonstration

	Demo 1 (Mario)	Demo 2 (Chart)
Global Search	5047	5132
Modified Rule-Based	989	906
Fast Auto-Focus (FAF)	646	526

Focus Time (milliseconds)

Performance Tests–Metrics

- Speed
  - Total Iterations (or Physical Time)
- Power Consumption
  - Total Distance Moved
- User Experience
  - In-focus position Overrun
- Accuracy*
  - Offset from Truth (deviation from perfect image; tolerance bound set by human perception)

* All tests were within tolerance for accuracy.

Performance Test – Results

Percentage improvement of Fast Auto-Focus over Modified Rule-Based Search

	Low End DSC, Wide Angle	Low End DSC, Telephoto	High End DSC, Wide Angle	High End DSC, Telephoto	Camera Phone
Time	10	15	48	38	28
Iteration	19	30	48	39	30
Distance	13	37	24	28	47
Overrun	-15	38	55	68	77

In practical terms, these results understate the potential improvement of FAF over current products, since many products on the market do not actually implement MRS.

Technology Benefits

- For Manufacturer
  - Universally applicable to platforms using contrast sensing auto-focus method
  - Speeds development time for new camera products
    - Lower development costs
    - Speed to market; capturing larger market share
  - Differentiates product, supporting premium pricing
  - Software implementation; compatible with existing camera systems
- For Consumer
  - Faster, more accurate auto-focus (take pictures more quickly, with better result)
  - Requires less power, so battery lasts longer
  - Improves user experience without requiring behavior change

Applicability

- This technology applies to any digital imaging device which performs focus adjustment via contrast measurements and lens positioning.
  - Digital still cameras (DSCs)
  - Camera phones
  - Some digital video cameras
  - Other image sensors
- Independent of image sensor type (CMOS, CCD, etc.)

Intellectual Property

- Notice of Allowance received for US patent
- All foreign rights preserved; foreign filings can be made as appropriate
- Licensees/partners will have input to foreign patent prosecution strategy
- Assignee: University of Texas System Board of Regents

Inventors

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Additional Materials for Review

- Non-confidential
  - Matlab simulator
    - Generates four performance metrics for any auto-focus search algorithm
      - Focusing speed (number of AF loop iterations)
      - Accuracy (deviation from sharpness peak)
      - Power consumption (total distance traveled by motor)
      - User experience (peak hunting distance)
    - Can be used to compare performance of FAF technology to user-generated baseline
    - Unpublished white paper
    - Published US patent application; PCT application