

## **Tutorial Proposal – Sibgrapi 2010**

**Title:** Development of Computer Graphics and Digital Image Processing Applications on the iPhone

**Type:** Regular

**Level:** Elementary

**Abstract:**

The iPhone is one of the most powerful, complete and versatile portable phones on the market. There are presently more than 150.000 applications available for the iPhone, and its users had downloaded more than three billion applications so far.

The iPhone have several capabilities that makes it an interesting platform for the development of applications that use image processing, computer graphics and/or pattern recognition algorithms: it is stable, popular, powerful, flexible and of course portable. What can a developer expect from the platform? What, in practical terms, can be done to implement those types of algorithms, and at which price?

This short course presents concepts and practical issues on the developing of image processing, computer graphics and pattern recognition applications on the iPhone. Code snippets will be provided, and issues such as memory management, capabilities and limitations will be discussed.

**Motivation:**

The iPhone and the iPad are very powerful tools that require a new human-computer interface for their operation. Users no longer interact with those devices by dragging a mouse around and clicking on buttons – these traditional interaction methods has been replaced with interaction via touch gestures, natural language, moving the device, etc.

Interaction with those devices can greatly benefit from techniques from computer vision, image processing, graphics, enhanced reality, etc. Most of these techniques were part of science fiction movies until not long ago, but now can be deployed in a portable device, and with new and comprehensive APIs that allows the development of easy-to-use and intriguing applications.

On this short course, we will present the iPhone and iPad devices, their capabilities and limitations and how they can be used to implement portable image processing applications, both to enhance usability of their user interfaces and as portable image-related data collection devices.

We will show how to implement basic digital image processing and computer graphics algorithms on the iPhone (with comments on development for the iPad as well). We will also discuss the hardware performance and we will show several cases where advanced algorithms has been deployed on the top of the iPhone OS platform.

By the end of this course the participants should have a good understanding of what the iPhone and iPad platforms are and what image processing and computer graphics function they can (or cannot) perform. Participants will also be able to understand the basic image processing techniques used for gesture detection, enhanced reality, computer vision, etc. applied to the iPhone/iPad.

Some examples of applications, with source code, will be presented, and some applications developed by others (which uses or exemplifies techniques of image processing, augmented reality, computer graphics, etc.) will be commented upon.

The short course will also contain information about the Apple's App Store – the marketplace where developers can distribute their applications for free or for a fee.

The short course will not use a laboratory, but will be as practical as possible, with examples of code and a short demonstration on application deployment.

**Target Audience:**

Students and professionals interested in learning the practical aspects of image processing in a portable device, programmers interested in developing image processing applications for the iPhone/iPad.

**Interest for the CV, IP, CG and PR community:**

The main purpose of this short course is to demonstrate the advantages and capabilities of the iPhone/iPad platforms for mobile image processing and computer graphics applications. We will also demonstrate the iPhone hardware capability and how it could expand the horizons of traditional algorithms, originally designed for the desktop platform; and open new research areas that will be enabled by taking advantage of the full potential of iPhone/iPad hardware. We will also discuss the image processing and computer graphics algorithms that can and cannot be deployed on a mobile platform.

**List of Topics:****Introduction**

- Why image processing/computer graphics on a mobile platform? Why the iPhone?
- Advantages and limitations of the iPhone as a mobile image processing/computer graphics platform. Acquisition, processing, storage and display capabilities and limitations. Additional features of the iPhone than can be used in image processing, computer graphics and augmented reality applications.
- Developing and deploying applications on the iPhone: Xcode, Mac OS X, the Apple Store and other issues.

**Basics**

- A very short introduction to Objective-C, the language used to develop for the iPhone. Comparisons with C, C++ and Java. “Hello World” for the iPhone.
- Introduction to Cocoa Touch, the basic User Interface kit (UIKit) provided for building iPhone Applications. A first application for the iPhone with a rich user interface.
- Introduction to Event Handling and basic gesture processing. An application to switch images on the display.
- Introduction to Core Animation, the UI Interactive framework. An application for smoothly moving images around the screen.
- Introduction to the Quartz Core Drawing API and Core Graphics. Drawing of graphics primitives.

**Image representation and processing on the iPhone**

- Using UIImageView to show images. Basic image display. Pan and zoom of displayed images.
- CGContextRef, CGContext and images as pixels (RGBA Matrices). Creating images from data (pixel by pixel). Manipulating pixels on the images. Drawing over images.

**Input and output**

- Image formats used by the iPhone. Differences between those formats, their capabilities and weaknesses.
- Reading images from an URL – basic network access.
- Acquiring images from the camera or the film roll.
- Storing images locally on the film roll.
- Sending images by e-mail.

**Other topics**

- Implementation of computing-intensive algorithms on the iPhone. Limitations and capabilities. Memory and CPU usage management.
- Example of implementation of a neural network for pattern recognition on the iPhone.

**Application examples**

- Implementation of some basic image processing algorithms on the iPhone. Recognition of visual elements in images. Basic pattern recognition applied to images: cars number plate recognition.
- Other examples of complete applications developed by the presenters.
- Comments on some applications developed by other programmers.
- Suggestions for image processing/computer graphics/pattern recognition projects for fun and profit.

**Presentation requirements:**

Just a projector (presenters will use a MacBook for presentation with that projector; and, if time allows, to demonstrate the development/deployment cycle).

**Short biography of the instructors:**

**Luciano Godoy Fagundes** is currently working on his PhD degree at INPE (Instituto Nacional de Pesquisas Espaciais) in Brazil. He obtained his Masters at ITA (Instituto Técnico de Aeronáutica) and his Master in Business Administration specialization at FGV (Fundação Getúlio Vargas). He has been part of Avaya Inc/ Lucent Technologies for the last 12 years where he worked as Professional Services Consultant, become a System Engineer of Bell Labs and has been a new Solution engineer, bringing new technologies to Caribbean and Latin America for the last 5 years. He has founded a start-up company Babs2Go in 2009 in order to start distributing iPhone Apps on the App Store. His Lattes CV can be accessed at <http://lattes.cnpq.br/5610956520536894>

**Rafael Santos** obtained his Masters and PhD in applied artificial intelligence at the Kyushu Institute of Technology in Fukuoka, Japan; respectively in 1995 and 1998, with a grant from the Japanese Ministry of Education. Presently he is a technologist at the National Institute for Space Research (INPE), working with research and development in image processing, data mining and intelligent web systems with applications on remote sensing, sensor networks and education/outreach. He is the author of the book (in Portuguese) *"Introdução à Programação Orientada a Objetos usando Java"*, part of the Campus/SBC textbook collection, and author of several tutorials, short courses and talks on data mining, visualization, image processing and programming, including the on-line book *Java Image Processing Cookbook* (<http://www.lac.inpe.br/JIPCookbook/index.jsp>). His Lattes CV can be accessed at <http://lattes.cnpq.br/0096913881679975>

**Additional Information**

The call for proposals asked for the planned material to be distributed to the participants, but for the time being we don't have it ready. Should the proposal be accepted, the presentation material and full source code used on it will be published in one of the authors' web pages before the presentation, and digital copies will be made available for the participants.