Keynote 1
The Quest for Lognormality in a Curved Gaussian Space-Time:
An On-line Handwriting Generation Journey
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Handwriting is a very complex neuromotor skill requiring the interaction of many cognitive processes. It normally aims at producing a message to be memorized as an ink trace left on a writing medium. At the core of this ability stands the control of neuromuscular networks by the Central Nervous System, each of these being made up of a large number of neural and muscular coupled sub-systems. According to Kinematic Theory of rapid human movements, the trajectory of a pen tip can be seen as a time superimposition of strokes, each one being described by a lognormal function and considered as the basic unit of handwriting. This paradigm, which relies on the Central Limit Theorem, has not only been experimentally confirmed in numerous predictive and physiologically significant tests but it has also been shown to be the ideal mathematical description for the impulse response of a neuromuscular system. This demonstration suggests that lognormal velocity patterns, which are the results of an asymptotic convergence, can be interpreted as reflecting the behavior of subjects who are in perfect control of their movements, hereafter referred to as lognormal writers. To illustrate this definition, we present various software tools and psychophysical tests used to investigate these ideal behaviors. We emphasize how the lognormal parameters extracted during various tasks can be used to analyze some underlying psychophysical processes associated with their realization, pointing out successful strategies for accomplishing a given task. To investigate the convergence toward lognormality, we report a few original projects conducted by our team and our collaborators. On the one hand, we focus on handwriting learning, to illustrate for example how kindergarten children move toward lognormality as they become more fluent writers. On the other hand, we exemplify how aging phenomena affect handwriting by pointing out the increasing departure from the ideal lognormal behavior as the control of the fine motricity begins to decline. We particularly focus on investigations dealing with brain strokes, Parkinson and Alzheimer diseases to point out how the lognormal parameter sets obtained from the model could also be used as a metric to characterize some disabilities and their evolution with time.

Then we show how lognormality can be exploited as a reference for the automatic generation of huge human like database of synthetic gestures, signatures and script independent handwritten patterns. We also present some CAPTCHA applications and discuss the potential impact of the theory on signature verification, writer identification and text recognition. Among other things, this lecture aims at elaborating a theoretical background for many handwriting applications as well as providing some basic knowledge that could be integrated or taking care of in the development of new automatic pattern recognition systems to be exploited in on-line and off-line document analysis and recognition as well as in biomedical engineering and cognitive neurosciences.
In the brief last part of this conference, we go far off the beaten track along the present mindset and focus on the writing environment taken in its most general physical description. We come back to the basic methodology that has been followed to develop the Kinematic Theory and model handwriting strokes. The importance and the universality of the Central Limit Theorem is pointed out and exploited. Particularly, we show how this theorem can be utilized to track a very puzzling problem in theoretical physics: the unification of quantum mechanics and general relativity\textsuperscript{1}. After a very brief overview of the main concepts behind each theory, we illustrate how Bayesian pattern recognition techniques can be applied to the Einstein field equation to study the Universe, as locally represented as a curved Gaussian field in the surround of a star. Exploiting a statistical pattern recognition paradigm, we show how this leads to considering the four physical interactions as emerging patterns and the fundamental constants of Nature as scale factor parameters of the whole representation.

Keynote 2

Imaging Technologies and the Impending New “Golden Age” in Manuscript Studies

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The imaging of the visual appearance of manuscripts for wide dissemination via the internet is now widely practiced and has dramatically changed the lives of manuscript scholars. Rather than having to travel to distant repositories of unique works, scholars may now study a variety of manuscripts while sitting in their offices. Valuable though this may be, further advances in imaging and computing technologies have also been applied to take an additional step: to recover writings from erased or otherwise damaged manuscripts that may have been thought lost or even whose existence was unsuspected. The proliferation of imaging systems and processing methods aimed at this goal has already begun and promises a deluge of new imagery to be interpreted. Examples will be drawn from a range of projects in this area, including studies of the Archimedes palimpsest, a Syriac palimpsest with a medical undertext, the David Livingstone 1871 African field diaries, a manuscript of a French poem that was damaged in the Dresden bombings, and the collection of palimpsests at St. Catherine's Monastery in Sinai.
Keynote 3
Why are Graphics Tools Less General than Text Tools?
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Our text retrieval algorithms work on documents in any subject area and even in many different languages. Our graphics algorithms, such as they are, are specialized for different areas: maps, CAD, sketching, facial analysis, natural scenes, and the like. And yet text would seem to be the more complex problem: we can teach pigeons to do scene recognition, but not to do anything with text. Perhaps images are fundamentally like syntax: what matters are the relationships between objects and not the names of the objects. Perhaps the analysis of graphical portions of documents should focus on their structure and not their elemental composition.