Concept Paper

Air-Spacecraft of the Third Millennium

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Capitalizing on the strength of mathematics having the power of generalization and the power of application to formulate and propose *smart* solutions, which enhance man's quality of life, I intend to design, develop and fabricate passenger aircrafts, traveling, partly, in space in the ballistic orbits; this technology, already, being used in targeted spacecrafts. The benefits include:

a) Reduction in travel time
b) Reduction in fuel consumption (most of the flight shall be in the ballistic phase, consuming no fuel), which could be passed on to customer as reduction in ticket price
c) Reduction in engine noise (most of the flight shall be in the ballistic phase, during which the engines would not be operating)
d) Safety (engines would not be required in the ballistic phase, thus reducing the risk of engine failure)

A Nobel laureate was asked, "What is the key to your success?" He replied, "I know what I am doing, in depth, and know a little bit about other disciplines". This strategy of complete knowledge of the problem at hand and knowledge of the associated fields is to be applied to bring out efficient, elegant and innovative solutions to develop *Air-Spacecraft of the Third Millennium (ASTM)*, using the techniques of mathematics, transforming the concepts and the equations into practical technologies, the bridge passing through physics and engineering. Modeling of system, environment and sources of error to be done using mathematical tools, fine-tuning to be done through simulations and test runs, followed by validation through field trials.

ASTM shall have its payload as passengers and cargo, and could reach New York from Karachi in less than an hour; the fare charged might be comparable to what is, currently, being charged by airlines for a trip from Karachi to Dubai. ASTM shall have its own Inertial Navigation System (INS), in addition to Global Positioning System (GPS). These systems will generate navigational information, whereas the desired trajectory, drawn-up in the elliptic-astrodynamical-coördinate mesh (the ballistic orbit being ellipse) [1], shall be computed by an appropriate guidance scheme — a possible combination of the Lambert scheme (incorporating cross-range error) [2] and the multi-stage-Q system [3]. Corrections can be achieved by applying control laws — the extended-cross-product steering [4] and the ellipse-orientation steering [5]. Final check, ascertaining that the corrections have been achieved, might be possible by employing the dot-product steering [6]. Of course, re-entry phase has to be, carefully, designed and monitored.

For cargo transport, this seems to be an ideal solution. Even before the necessary database is established for human travel, ASTM could be used to transport checked baggage of passengers (earlier than their own arrival at destination), leaving more space in conventional aircrafts for passengers, thus reducing fuel-per-passenger ratio.

The real challenge, on the other hand, shall lie in learning the effects of enhanced and reduced gravity on physiological systems [7], *e. g.*, functions of brain, heart and spinal column as well as flow of blood, *etc.* Some theoretical estimates have, already, been made [8]. However, there seems to be a need to study these effects in the light of various models of brain [9, 10], heart [11], spinal column [12], in particular, for the pediatric and the geriatric populations. During reduced gravity, there will be increased blood flow to upper torso and brain. Moiré fringe topography and rasterstereography [13, 14] could be used to study and model changes in shapes and curvatures of upper torso during altered-gravity situations.

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From the investment point of view, a thorough risk analysis needs to be conducted for this project. This analysis should, not only, focus on the amount involved, but also, investigate the possibilities of attracting outside investment. If successful, ASTM has the potential to take over the travel market (after the initial apprehensions of trying out something new are overcome).

1. Kamal SA. Use of astrodynamical coördinates to study bounded-keplarian motion. *The Fifth Inter-national Pure Mathematics Conference*, the Quaid-é-Azam University and the Pakistan Mathematical Society, Islamabad, Pakistan, 2004, available at**:** http://www.ngds-ku.org/pub/confabst.htm#C60:
2. Kamal SA. Incorporating cross-range error in the Lambert scheme. *Proceedings of the Tenth Natio-nal Aeronautical Conference,* Edited by Sheikh SR, Khan AM, Pakistan Air Force Academy, Risalpur, NWFP, Pakistan, 2006, pp 255-263, available at**:** http://www.ngds-ku.org /pub/confabst.htm#C67:
3. Kamal SA, Mirza A. The multi-stage-Q System and the inverse-Q system for possible application in satellite-launch vehicle (SLV). *Proceedings of the Fourth International Bhurban Conference on App-lied Sciences and Technologies (IBCAST 2005)*, Volume 3, Control and Simulation, Edited by Hussain SI, Munir A, Kayani J, Samar R, Khan MA, National Center for Physics, Bhurban, NWFP, Pakistan, 2006, pp 27-33, available at**:** http://www.ngds-ku.org /pub/confabst.htm#C66:
4. Kamal SA. Incompleteness of cross-product steering and a mathematical formulation of extended-cross-product steering. *Proceedings of the First International Bhurban Conference on Applied Sciences and Technologies (IBCAST 2002)*, Edited by Hoorani HR, Munir A, Samar R, Zahir S, National Center for Physics, Bhurban, NWFP, Pakistan, 2003, pp 167-177, available at**:** http://www.ngds-ku.org/pub/ confabst.htm #C56: (no spaces in the address)
5. Kamal SA. Ellipse-orientation steering: a control law for spacecrafts and satellite-launch vehicles (SLV). *Space Science and Challenges of the Twenty-First Century*, ISPA-SUPARCO Collaborative Seminar (in connection with World Space Week), University of Karachi, 2005 (invited lecture), available at**:** http://www.ngds-ku.org /pub/confabst.htm#C64:
6. Kamal SA. Dot-product steering: a new control law for satellites and spacecrafts. *Proceedings of the First International Bhurban Conference on Applied Sciences and Technologies (IBCAST 2002)*, Edited by Hoorani HR, Munir A, Samar R, Zahir S, National Center for Physics, Bhurban, NWFP, Pakistan, 2003, pp 178-184, available at**:** http://www.ngds-ku.org /pub/confabst.htm#C55:
7. Kamal SA. Mathematical modeling of physiological systems. *The First World Conference on Twenty-First-Century Mathematics*, School of Mathematical Sciences, GC University, Lahore, Pakistan, 2004, abstract # 67, pp 19-20, available at**:** http://www.ngds-ku.org /pub/confabst.htm#C58:
8. Ahmed SN, Kamal SA, Siddiqui KA, Husain SA, Naeem M. EEG in weightlessness: a theoretical estimate. *Kar. U. J, Sc.* **25(1),** 1997, 19-24, available at**:** http://www.ngds-ku.org /pub/jourabst0.htm #J20:
9. Kamal SA, Siddiqui KA, Husain SA. Spacetime representation of global-electrocortical activity. *Biol. Cyber*. **60**, 1989, 307-309, available at**:** http://www.ngds-ku.org /pub/jourabst1.htm #J08:
10. Kamal SA, Siddiqui KA. The covariant-generalized-coupling model of global-electrocortical activity. *Kar. U. J. Sc.* **25(1)**, 1997, 29-39, available at**:** http://www.ngds-ku.org /pub/jourabst0.htm #J19:
11. Kamal SA, Siddiqui KA. The human heart as a system of standing waves. *Kar. U. J. Sc.* **30(1&2)**, 2002, 55-63, available at**:** http://www.ngds-ku.org /pub/jourabst.htm #J25:
12. Kamal SA. A 3-D-static model of the human spinal column. *Kar. U. J. Sc.* **24(1)**, 1996, 29-34, available at**:** http://www.ngds-ku.org /pub/jourabst0.htm #J18: (no spaces in the address)
13. Kamal SA. 3-D optical imaging and image processing (biomedical applications). *Proceedings of the International Workshop on Recent Advances in Computer Vision*, Edited by Laghari JR, Naqvi AA, Rajput AQ, Sangi NA, Shah MA, SZABIST, Karachi, Pakistan, 1998, pp 86-95, available at**:** http://www.ngds-ku. org/pub/confabst0.htm #C46: (no spaces in the address)
14. Kamal SA. Pattern recognition using moiré fringe topography and rasterstereography. *Proceedings of the International Symposium on Biometrics and Security Technologies (IEEE ISBAST 2008)*, Bahria University, Islamabad, Pakistan, 2008, pp 1-7, available at**:** http://www.ngds-ku.org /pub/confabst.htm#C68:

Main ideas for the first and the second paragraphs of this concept paper are taken from *Research Synopsis* (http://www.ngds-ku.org/goals/Univres.pdf). Contents of this concept paper were presented in *the Fifth Symposium on Computational Complexities, Innovations and Solutions* (Air-Spacecraft of the Third Millennium**:** http://www.ngds-ku.org/pub/confabstA.htm#C80:)

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