Foreword

Mars Orbiter Mission and its challenges

The Indian Space Programme had its beginnings with a thrust on application programmes of communication and remote sensing, in line with the vision of its founder, to apply technologies to address the problems of man and society. With time, it has been realised that to be one among the leading space faring nations, the space agencies need to foray into unexplored areas, so as to demonstrate contemporary scientific and technological capabilities. With this in view, ISRO in recent years has undertaken dedicated missions aimed at planetary exploration and scientific studies. This started with the Chandrayaan-1, India's first lunar exploration mission and now we have the Mars Orbiter Mission. These will be followed by ASTROSAT – an astronomy mission, Chandrayaan-2 – the second Lunar mission with capability to land and travel on lunar surface and Aditya – a mission that will study the Sun. The planetary missions provide excellent opportunities to develop space agency's capabilities in the area of technology advancement, miniaturization and spacecraft autonomy. It gives me great pleasure to see that *Current Science* is publishing this special section on the Mars Orbiter Mission.

The success of Mars Orbiter Mission to enter Mars orbit, as planned in its maiden attempt, has been hailed globally as a demonstration of what can be achieved with dedicated efforts and close interaction between the senior executives of ISRO who provided necessary guidance with expertise and younger members of the team who executed with great dedication and enthusiasm.

The technical challenges were numerous for this Mission. To mention a few of them are:

(1) Launch vehicle capability to launch the spacecraft with the precise velocity and argument of perigee, in order to have a good fuel margin of the spacecraft.
(2) Configuring the spacecraft to survive repeated traverses through the radiation belts of the Earth, during Earth bound manoeuvres and proceed on a heliocentric phase with associated extremes in temperature.
(3) Fine tuning of the path to precisely navigate the spacecraft during the heliocentric phase.
(4) Precise knowledge of orbital parameters and the velocity of the spacecraft and Mars, in order to ensure successful orbital insertion around Mars.
(5) Spacecraft autonomy to take care of eventualities associated with long travel times of signals.
(6) Several levels of redundancies for crucial systems like sensors, controls, accelerometer, feedback for motor and thruster firing.
(7) Successful re-activation of the Liquid Apogee Motor after 300 days in cold space, for Mars orbit insertion.
(8) Deep space communication capability over distances of more than 400 million km, and ground segment support and execution for interplanetary missions.

There were several situations when we had to take quick decisions and several others when we had to pre-programme the activities and let the actions happen automatically, including the crucial Mars orbit insertion. One more aspect of this mission which was very heartening was the extremely good accuracies we achieved in the performances resulting in fuel saving.

As readers may recall, the spacecraft was inserted into an elliptical orbit around Mars on 24 September 2014, and it has completed its originally designed life of 6 months, completed its 100th orbit on 22 June 2015 and is still going strong. It was safely positioned during the comet C/2013 A1 Siding Spring encounter with Mars and has survived without problems the blackout due to Mars–Sun conjunction during June this year.

This special section in *Current Science* is a collection of papers providing a brief glimpse of the technological achievements of this mission. We hope that several of the scientific results will also be brought out in forthcoming issues. By succeeding in its maiden attempt to put an orbiter around Mars in a very short time using meagre resources, ISRO has changed the global perspective of planetary exploration enthusiasts about the resource requirements for planetary exploration missions.

A. S. Kiran Kumar

Indian Space Research Organisation,
Bengaluru 560 231, India
e-mail: chairman@isro.gov.in