The 144 MHz EME NewsLetter

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Software

WSJT Version 4.9.2

is available for download from Joe, K1JT's website http://pulsar.princeton.edu/~joe/K1JT/ for about two weeks now.

The main enhancement compared to previous versions takes place in the JT65 module: It's an additional gain of about 4 dB compared with WSJT 4.7; also WSJT 4.9.2 introduces a new CW mode for EME.

On the outside the new WSJT looks nearly the same as its recent predecessors. A "CW" entry now appears on the Mode menu. This is presently a "transmit only" mode: it sends standard EME-style messages at 15 WPM, by keying an 800 Hz audio tone, and it takes care of the timing and T/R switching for you. Receiving is left up to the operator.

The most significant program enhancements are those made to the JT65 decoder. It has been transformed into a multi-layered procedure that takes better advantage of the structured nature of JT65 messages and the substantial computing capability that most WSJT users have in their hamshacks.

In the current version 4.9.2, if the initial JT65 decoding effort fails then deeper searches are attempted using an entirely different approach. The result is a net gain of about 4 dB over a wide range of circumstances.

Single line decodes at –30 dB!

The first feedback from the real world outside Joe's simulator confirms this. Single line decodes at signal levels of -28 or even -30 dB are frequently being reported. There is much less need (and waiting cycles) for the avering function like in WSJT 4.7 required now.

How does the new JT65 work?

JT65 is capable of transmitting and receiving 2^72 (about 5 x 10^21) distinct user messages. Instead of sending the minimum number of 72 information bits needed to to convey any one of those distinct messages, the program actually sends 63 six-bit "symbols" for a total of 378 bits

QRPP EME will receive another boost from the new WSJT version. Matej, OK1TEH, reports already three QSOs with RN6BN (with WSJT 4.7) though he's using just 50 watts and a 4 ele yagi...

in each transmission. The 302 extra bits comprise the powerful forward error correction (FEC) capability of the JT65 mode, allowing the system to function reliably with signals far below the audible threshold.

One of the first tasks of the JT65 decoder is to measure the signal level at each of the 64 data-tone frequencies during each of the 63 data intervals in a transmission. The program must then decide which one of the possible 2^72 messages was most likely the one sent. This procedure is necessarily probabilistic in nature. The best decoder will go as far down into the noise as possible, but it must also know when to give up so that it produces only very few false decodes.

The total of 2^72 distinct messages is far too many to permit each one to be tested individually against the received signal. However, an important characteristic of the Reed-Solomon FEC code used in JT65 is that well-defined mathematical algorithms can be used to direct the decoder toward the most likely candidate messages, based on the available signal information.

A mathematical inversion of the code is made possible by the organization of the redundant information contained in the 306 extra bits. The new JT65 decoder goes far beyond the capabilities of normal Reed-Solomon decoders. If the standard decoding procedure fails to produce a high-confidence solution, the program proceeds to search explicitly for each one of a number of messages that it considers likely or plausible on other grounds.

Nearly 2^28 (over 250 million) different callsigns can be accommodated in each of the two callsign fields of a JT65 message. Once again, this is far too many to permit an exhaustive search for them all.

Consequently, the "deep search decoder" takes the callsigns listed in the new file CALL3.TXT (located in the user's WSJT directory, it replaces the callsign.txt file used in previous versions) as being the most likely alternatives in the message's second field. A correlation algorithm is then applied to find out if one of these calls and its associated grid locator are present, combined with either "CQ" or the receiving station's callsign in the first field. High-confidence matching of this kind can be accomplished down to about -28 dB on the WSJT scale, in a single transmission, with a very low error rate.

The bottom line is that for any arbitrary callsign the new JT65 decoder performs at least as well as the one in WSJT version 4.7.0. Message averaging works just as it did before, and also if one is listening into a "third party" QSO between two other stations, the sensitivity will be the same as in version 4.7.0.

However, if a station that is listed in the file CALL3.TXT is calling CQ or is calling, the sensitivity will be again about 4 dB better on average.

Please note that the decoder is given **no information** whatsoever about what station one may be trying to work. Its heart is "as pure as the driven snow," even in a sked. However, the decoder does presume that the callsign of the transmitting station is more likely to be one listed in CALL3.TXT than any other random callsign.

The program always attempts to decode a purely arbitrary message first. Failing that, it will look more deeply in the noise for the presence of a message that includes the callsign of a station listed in the database file call3.txt. It is no accident that the algorithm just described bears close resemblance to the thought processes (conscious and otherwise) that we use to copy very weak CW by ear. Familiar combinations like CQ and one's own callsign are always easier to dig out of the noise than random combinations of characters. Callsigns that we have seen or heard before are more easily recognized than arbitrary calls generated at random. The new JT65 decoder behaves similarly, with one major exception - other as the human decoder in CW, it has not even a doubt about who one is trying to work.

All decoders make mistakes, and this one is no exception. Just like a human copying CW, the JT65 decoder has a "grey area" in which it finds a solution but may have only moderate confidence in it. In such cases the decoder appends a "?" to the decoded text, and the operator must make the final decision as to whether the decoding is correct. It is important to know that because of the mathematical message structure, incorrect decodings will not just differ from the correct one in a few characters; more likely, they will exhibit a whole incorrect callsign.

The program generates two numbers to characterize its level of confidence in decoded messages. In version 4.9.1, these numbers appeared at the end of each decoded text line. They are not displayed in the current version 4.9.2, but in tthe next version Joe will probably display them if the "Aggressive decoding" box is checked. The first number is 0 or 1 according to whether the soft-decision Reed Solomon decoder has failed or succeeded. The second number represents a confidence level on a 0-10 scale for messages decoded using the "deep search" algorithm. Anything under 3 is questionable; messages rated 6 and above are unlikely to be wrong, unless one is processing "garbage" data containing strong birdies, QRN, etc.

In other words: WSJT may from time to time display rubbish decodes such as an unexpected „DF2ZC ZL1RS“ even when one is just monitoring the band. In these cases the decode is marked with a „?“ to show the decoder is not at

all certain of the correct decode. So it‘s left to the operator to judge whether this is something correct or not based on DT, DF and other parameters. Also the fact that with Call3.txt the software has something like a „cheat file“ doesn‘t mean it has an advantage in decoding. **Call3.txt is no cheat file like they‘re known from CW EME.** It is nothing but a choice of callsigns the decoder is searching for in the noise. The simple reason behind is that the computer capacity is too little and the time required is too much to search for each of the possible hundreds of millions of combinations.

As one gains experience in recognizing the graphical and numerical indications of proper message synchronization and the effects of "birdies" and other interference, one will become adept at making these decisions when necessary.

With added on-the-air experience Joe will probably be able to reduce the decoder's error rate, as well.

Random Work convienience
Joe has also programmed some minor important things which make the usability of the software easier. For instance, when working Random the process can now be speeded up by at least one sequence: Double-clicking on a callsign in either one of the decoded text windows will cause that callsign to be copied into the "To Radio" box. The call will then be looked up in the database and will be inserted appropriately into the transmit message boxes Tx1 and Tx2. This feature is designed to facilitate random JT65 operation by making it easy to call a station you have just copied calling CQ, or responding to your CQ. The few seconds between decode and start of transmissions were mostly too short to enter the callsign and click „Generate Standard messages“ and click Tx1 then.

QSO Reports

EA3DXU (JN11)...

...counted 51 EME QSOs in January of which 48 were JT65B and 3 CW. Stations worked random 144 MHz are ON4GG, IK1UWL, F9DO, PA3DZL, UA9SL, W5UN, W7EME, DL7UAE, F9HS, S52LM, ON4IQ, K7MAC, K2BLA, OE5MPL, N5BLZ, RA3AQ, KB8RQ, EA5SE, DL8GP, RV9JD, K2TXB, DL8YHR, RK3FG, I6WJB, K3MF, I2FAK, RU1AA, UA9FAD, DK8ZJ and AA7A .

K6PF (DM13)...

...handed in his January report: „Since my last report which went through 2 January, I was able to pick up 5 more initials during the remainder of January.

15 January:
VK2KU - O/RO. (#199) - weak but consistent sig fm Guy. Tx/Rx V pol

26 January:
OZ4MM - RO/O. (#200) - nice sig fm Stig's 10m dish. Tx/Rx - H pol
SM5CUI - O/RO. (#201) - vy nice signal fm Rune once his gnd gain kicked in. Tx/Rx - H pol

27 January:
DF6NA - RO/O. (#202) - weak but consistent signal fm Rainer apparently because faraday was stuck in between H & V pol here the entire sked. Tx/Rx - H & V pol

28 January:
IW4BLG/3 - N/C, I only copied O's fm Pierluigi.

29 January:
RA3IS - RO/O. (#203) - finally completed a QSO with Sergey after 13 prior skeds which all had nil copied on my end. Amazingly, he popped up out of the noise during one sequence that allowed this sked to be completed. NEVER GIVE UP! Tx/Rx - H & V pol
YO3FFF - N/C, I only copied partial calls & O's fm Cristi using his single yagi.

January 2005 was a great month picking up 9 new initials & 6 new grids, all on CW. Great way to start the new year.“

Activity Updates

ST2RS (KK65)

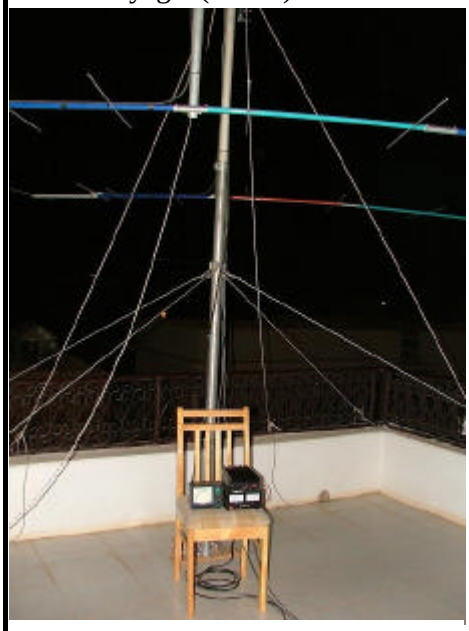
Bob, ZL1RS, has managed to put up some EME gear during his business related stay in Sudan. He will still

Bob, ST2RS/ZL1RS in his shack

ST2RS (KK65GN)

be QRV from there until February 15th so if you haven‘t worked ST yet, there‘s still an opportunity.

Bob put up four homebrew 8-elements-yagis (1.7 wl) on his 3m x 4m appartment terrace with a broom-stick construction. They yield approx 16.5 dBd. To make the array fit on the terrace he had to understack it in the e-plane.



As close as it gets...ST2RS‘ amp at the antenna

Rig is a IC-706mk2g + Mirage B3016 PA at 140 W o/p at the antenna to minimise feedline loss. With this setup he completed 16 QSOs until January 21st. Now a second B3016 has been added so another 3 dB make Bob‘s sigs even stronger. Of course ST2RS suffers from some city QRN - and from chronic sleep deprivation...

VK2KU (QF55)

Bad news: Guy is off air. Only few weeks after he reported „all systems go“ a lightning dammage occurred. After prolonged and severe electrical storms on January 31st. The full extent of the dammage is not yet clear but it doesn#t look as bad as one could fear. Rotors seem to work but controls have suffered, the FT763 at least isn‘t dead but also not 100%, the 400 W amp hasn‘t been checked yet but may perhaps be o.k. No surprise that the antenna preamp is dead.

Guy will be off air at least for some weeks.

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is produced monthly.